

DEPARTMENT OF THE INTERIOR

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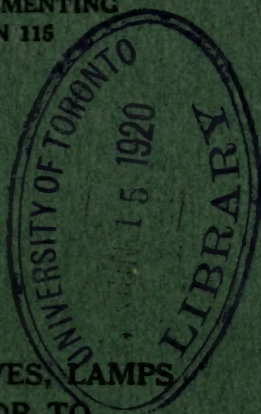
COAL-MINE FATALITIES IN THE
UNITED STATES

1919

AND COAL-MINE STATISTICS SUPPLEMENTING
THOSE PUBLISHED IN BULLETIN 115

BY

ALBERT H. FAY



ENGINEERING

STORAGE

LIST OF PERMISSIBLE EXPLOSIVES, LAMPS
AND MOTORS TESTED PRIOR TO
JANUARY 31, 1920



WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

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First edition February, 1920.

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COAL-MINE FATALITIES IN THE UNITED STATES, 1919.

By ALBERT H. FAY.

PRELIMINARY STATEMENT.

Through the hearty cooperation of the State coal-mine inspectors, the bureau is able to present in this paper ^a a complete statement of the coal-mine fatalities occurring throughout the United States during the calendar year 1919.

The reports received from the inspectors for the year just closed show a reduction of 10.58 per cent in coal-mine fatalities as compared with 1918, while in 1918 the reduction was 4.3 per cent from 1917 figures. The total number killed was 2,307 in 1919 and 2,580 in 1918, a reduction of 273.

There was a decrease of 128, or 25 per cent, in fatalities resulting from mine cars and locomotives, and a decrease of 198, or 15 per cent, in the fatalities due to fall of coal or rock. Surface accidents show a decline of about 25 per cent as compared with the previous year. There were, however, increases in accidents due to gas and dust explosions and also explosives. There occurred during the year nine disasters in which five or more men were killed, representing a total of 201 fatalities.

The worst disaster of the year was the one occurring at the Baltimore Tunnel No. 2, Wilkes-Barre, Pa., resulting from the explosion or burning of a number of kegs of powder, by which 92 lives were lost. This disaster emphasizes the need for stricter regulations relating to hauling men and explosives into the mine at the same time. The question of whether electricity was responsible or not does not affect the consideration of the various dangers which arise in underground transportation and handling of explosives. At best the handling and hauling of explosives is hazardous and such being the case, no one, other than the necessary attendants, should be permitted to ride in cars or cages transporting explosives. As a result of this disaster, the report ^b of the coroner's jury to the governor of Pennsylvania brings out some important dangers to be avoided in the use and transportation of explosives.

The conditions under which the mines were operated in 1919 were not normal as the country has not become adjusted to the new commercial conditions as a result of the war. There were numerous labor troubles during the year and on November 1 a strike almost completely shut down the central bituminous field, with the result

^a This report also contains many statistics supplementing those published in Bulletin No. 115, Bureau of Mines, entitled "Coal-Mine Fatalities in the United States, 1870-1914."

^b Monthly Statement of Coal-mine Fatalities in the United States, Bureau of Mines, June, 1919, p. 16

that but little coal was mined during the month of November and early part of December. According to the preliminary estimates by the United States Geological Survey for the year 1919 the total production was 458,063,000 tons of bituminous coal which is a reduction of 121,323,000 tons as compared with the previous year. The anthracite production is estimated by the United States Geological Survey as 86,200,000 tons, or a reduction of 12,600,000 tons from the preceding year.

While the actual number of fatalities is considerably less than in 1918, the ratio, on a tonnage basis, is slightly higher. The number of tons produced per fatality in 1918 in the bituminous mines was 285,552 as compared with 274,000 tons per fatality in 1919. In the anthracite field the production per fatality in 1918 was 179,358 tons as compared with 135,700 tons per fatality in 1919. The average for the entire coal-mining industry was 235,900 tons per fatality as compared with 262,873 in 1918; 241,618 in 1917; 265,094 in 1916; and 234,297 in 1915.

Complete figures showing the number of men employed are not available, but estimates received from the inspectors total about 765,000. Although the number of names on the pay rolls may be slightly in excess of 1918, the actual number of days labor performed during the year will be much less than in the preceding year because of the irregular working of the mines on account of car shortage, strikes, and the unsettled demand for coal. When the number of employees is properly weighted on the basis of full-time workers, the reduction in accident rates may not be as great as first appears. This rate on a tonnage basis does not show any improvement; in fact, the contrary is indicated.

TABLE 1.—*Coal-mine fatalities, also production statistics, 1907 to 1919, inclusive.*

[Supplemental to Table 2, Bureau of Mines, Bulletin 115, in which similar data extend back to 1870.]

Year.	Average days active.	Men employed.	Men killed.	Killed per 1,000 employed. ^a	Killed per 1,000 300-day workers. ^a	Production per death, short tons.	Average production per man.	
							Per year, tons.	Per day, tons.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1907.....	231	680,492	3,242	4.76	6.19	147,407	708	3.06
1908.....	195	690,438	2,445	3.54	5.45	167,407	603	3.09
1909.....	.....	666,552	2,642	3.96	.....	174,416	691	.....
1910.....	220	725,030	2,821	3.89	5.31	177,808	692	3.15
1911.....	220	728,348	2,656	3.65	4.97	186,887	682	3.10
1912.....	225	722,662	2,419	3.35	4.46	220,945	740	3.29
1913.....	238	747,644	2,785	3.73	4.70	204,685	762	3.20
1914.....	207	763,185	2,454	3.22	4.66	209,261	673	3.25
1915.....	209	734,008	2,269	3.09	4.44	234,297	724	3.46
1916.....	235	720,971	2,226	3.09	3.93	265,094	818	3.48
1917.....	251	757,317	2,696	3.56	4.25	241,618	860	3.43
1918.....	258	762,426	2,580	3.38	3.94	262,873	890	3.45
1919.....	.....	.....	2,307	.....	.....	235,900	.....	.....

^a Column 4 gives in the usual way the fatality rate based upon the actual number of employees, regardless of the length of time worked. Column 5 gives a fatality rate based on 1,000 300-day workers. This rate is comparable, one year with another, also one group with another, as the time element has been taken into consideration and all labor equated to a 300-day basis.

^b Subject to revision.

TABLE 2.—*United States: Fatalities at coal mines for the years ended Dec. 31, 1918, and 1919.*

Cause.	Number killed.		Increase or decrease.	Percentage of increase or decrease.
	1918	1919		
Underground:				
Falls of roof or face.....	1,294	1,006	-198	-15.30
Mine cars and locomotives.....	506	378	-128	-25.30
Gas and dust explosions.....	129	190	+ 61	+47.29
Explosives.....	135	206	+ 71	+52.59
Electricity.....	88	69	- 19	-21.59
Miscellaneous underground.....	129	131	+ 2	+1.55
Total underground.....	2,281	2,070	-211	-10.19
Shaft: Total shaft.....	52	52		
Surface:				
Haulage.....	118	91	- 27	-22.88
Machinery.....	47	28	- 19	-40.43
Miscellaneous.....	82	66	- 16	-19.51
Total surface.....	247	185	- 62	-25.10
Grand total.....	2,580	2,307	-273	-10.58

COAL-MINE FATALITIES, 1870 TO 1919.

In addition to giving monthly fatality tables for 1919, this report includes several tables that were published in various monthly statements since 1914, thus making available in one publication all of the data compiled since that time. Many of these tables are supplemental to those published in Bulletin 115, "Coal-Mine Fatalities in the United States, 1870-1914," so that this report may be considered as a supplement to that bulletin. Where tables are actually supplemental to those published in the above-mentioned bulletin, as Tables 24, 25, 26, and 27, reference to the earlier table is given so that all who have Bulletin 115 may be able to trace the compiled data back to the beginning of the inspection service in the various States.

ACKNOWLEDGMENTS.

Grateful acknowledgment is hereby tendered to the mine inspectors who have cooperated in the collection of statistics. In a number of States the coal-mine fatalities are reported by the chief inspector, but for other States the reports are received from the district inspectors. The list of inspectors and State mine officials who cooperate is given on page 79. The author acknowledges the assistance rendered by Miss Lillian Chenoweth, and Mr. W. W. Adams, of the Bureau of Mines, in the preparation of the various tables.

CAUSES OF COAL-MINE FATALITIES IN 1919, BY STATES AND MONTHS.

The causes of the coal-mine fatalities by States and months for 1919 are shown in Tables 2 to 16, inclusive.

TABLE 3.—United States: Coal-mine fatalities during the year ended Dec. 31, 1919, by causes and States.

State.	Underground.										Shaft.			Surface.					Total by States.					
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	(Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Cages, skip, or bucket.	Other causes.	Total.	Electricity.		Mine cars and mine locomotives.	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.
Alabama.	36	15	2	22	2	2	9	1	1	88	1	1	88	1	1	3	5	93	1	1	1	3	110	
Alaska.	6	1	1	1	1	1	1	1	1	9	1	1	9	1	1	1	1	10	1	1	1	1	13	
Arkansas.	20	8	31	7	2	2	6	1	1	87	1	1	87	1	1	1	3	91	1	1	1	1	71	
California, Idaho, and Nevada.	77	9	43	17	10	5	1	9	1	157	2	4	157	6	4	4	10	169	1	1	1	1	238	
Colorado.	33	11	3	1	1	1	2	1	1	76	2	3	76	2	3	3	5	83	1	1	1	1	100	
Georgia and North Carolina.	11	3	1	1	1	1	1	1	1	17	1	1	17	1	1	1	2	17	1	1	1	1	31	
Illinois.	14	1	1	1	1	1	1	1	1	21	1	1	21	1	1	1	2	25	1	1	1	1	32	
Indiana.	42	1	1	1	1	1	1	1	1	72	1	1	72	1	1	1	2	84	1	1	1	1	77	
Iowa.	2	1	1	1	1	1	1	1	1	9	1	1	9	1	1	1	2	10	1	1	1	1	12	
Kansas.	3	1	1	1	1	1	1	1	1	8	1	1	8	1	1	1	2	11	1	1	1	1	17	
Kentucky.	2	1	1	1	1	1	1	1	1	9	1	1	9	1	1	1	2	11	1	1	1	1	13	
Maryland.	5	1	1	1	1	1	1	1	1	8	1	1	8	1	1	1	2	10	1	1	1	1	17	
Michigan.	2	1	1	1	1	1	1	1	1	9	1	1	9	1	1	1	2	11	1	1	1	1	31	
Missouri.	2	1	1	1	1	1	1	1	1	8	1	1	8	1	1	1	2	10	1	1	1	1	12	
Montana.	14	1	6	1	1	1	1	1	1	20	1	1	20	1	1	1	2	25	1	1	1	1	32	
New Mexico.	70	1	19	2	10	3	3	3	1	133	1	1	133	1	1	1	2	142	3	3	2	2	149	
North Dakota.	11	5	16	1	1	1	1	1	1	36	1	1	36	1	1	1	7	36	1	1	1	1	31	
Ohio.	188	36	79	10	17	17	12	9	2	362	9	4	362	3	1	3	10	399	9	2	5	4	491	
Oregon.	18	8	1	1	1	1	1	1	1	27	1	1	27	1	1	1	27	27	0	0	0	0	0	
Pennsylvania (bituminous).	13	1	6	1	1	1	1	1	1	24	1	1	24	1	1	1	3	3	0	0	0	0	7	
South Dakota.	5	4	2	1	1	1	1	1	1	6	1	1	6	1	1	1	1	25	1	1	1	1	19	
Tennessee.	3	2	1	1	1	1	1	1	1	6	1	1	6	1	1	1	5	28	2	2	1	1	33	
Texas.	170	17	63	15	6	6	12	6	0	294	2	1	294	1	1	1	34	330	20	1	2	1	437	
Utah.	19	3	4	3	1	2	1	1	1	33	1	1	33	1	1	1	33	33	41	1	2	1	41	
Virginia.	770	97	305	101	47	57	65	1	26	28	28	28	1,624	13	4	17	39	1,672	41	11	2	14	33	2,029
Washington.	172	57	73	42	140	6	4	1	1	546	7	2	546	7	2	3	76	1,672	41	11	4	7	635	551
West Virginia.	942	164	378	143	47	206	11	69	2	28	22	70	2,070	20	6	20	185	2,307	40	23	6	81	237	2,580
Wyoming.	1,162	112	506	95	34	135	15	88	3	17	26	63	2,281	21	9	17	52	2,307	40	23	7	91	67	2,580
Total (bituminous)	770	97	305	101	47	57	65	1	26	28	28	28	1,624	13	4	17	39	1,672	41	11	2	14	33	2,029
Pennsylvania (anthracite)	172	57	73	42	140	6	4	1	1	546	7	2	546	7	2	3	76	1,672	41	11	4	7	635	551
Total 1919	942	164	378	143	47	206	11	69	2	28	22	70	2,070	20	6	20	185	2,307	40	23	6	81	237	2,580
Total 1918	1,162	112	506	95	34	135	15	88	3	17	26	63	2,281	21	9	17	52	2,307	40	23	7	91	67	2,580

a Figures for Kentucky for 1919 throughout this report are subject to revision.

TABLE 4.—United States: Coal-mine fatalities during the year ended Dec. 31, 1919, by causes and months.

Month.	Underground.										Shaft.					Surface.					Grand total.					
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity.		Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.
January.....	61	17	42	7	1	15	1	4	3	1	2	4	155	2	3	1	1	3	9	9	1	4	1	1	9	24
February.....	74	7	35	13	2	4	2	3	3	1	3	3	144	3	3	3	1	0	3	3	1	3	1	1	1	13
March.....	81	14	26	18	3	5	1	2	2	1	1	5	157	1	1	1	1	3	3	3	1	2	3	1	1	15
April.....	81	11	33	5	23	6	2	2	2	2	1	9	166	1	1	2	3	3	5	5	3	1	1	2	2	13
May.....	86	8	33	...	7	15	...	5	1	2	2	0	166	1	1	2	3	2	5	5	1	3	1	1	1	12
June.....	87	13	31	25	...	98	...	2	1	3	3	2	271	3	1	2	3	6	6	10	3	1	3	1	1	19
July.....	92	11	33	19	...	14	2	14	...	6	0	9	196	6	3	3	3	6	3	10	1	...	...	...	...	12
August.....	89	18	55	31	...	12	1	7	...	2	0	9	205	6	6	3	3	6	8	8	3	...	...	...	...	12
September.....	77	16	31	4	...	9	1	10	...	3	7	2	157	2	1	2	3	4	8	4	3	9	1	2	5	18
October.....	99	16	38	11	...	13	1	10	...	3	20	5	216	1	1	1	6	4	8	3	2	1	2	5	15	18
November.....	46	8	17	6	...	6	...	2	...	1	1	2	88	1	1	...	...	2	2	2	2	1	1	1	6	94
December.....	69	15	25	4	11	9	...	4	...	1	8	8	146	...	...	...	4	4	0	0	10	...	...	...	7	19
Total, 1919.....	942	154	378	143	47	206	11	69	2	10	22	70	2,070	20	6	20	6	52	70	10	23	6	21	56	185	2,307

TABLE 5.—United States: Coal-mine fatalities during January, 1919, by causes and States.

State.	Underground.										Shaft.			Surface.					Total by States.						
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.		Mine cars and mine locomotives.	Electricity.	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.
Alabama.....	2		3					1					6						1						7
Alaska.....													2						0						0
Arkansas.....	2																		0						2
California, Idaho, and Nevada.....																			0						0
Colorado.....	6												6			1			7						7
Georgia and North Carolina.....			4																0						0
Illinois.....	4		2					1					9						11						24
Indiana.....	1												3						3						3
Iowa.....	1		1										2						1						2
Kansas.....													1						1						1
Kentucky.....													1						2						2
Maryland.....	1												1						3						3
Michigan.....			1										1						2						2
Missouri.....													1						1						1
Montana.....			1										1						1						1
New Mexico.....			1										1						1						1
North Dakota.....	2		1										3						3						3
Ohio.....	6		2					1					9						9						12
Oklahoma.....	1												1						1						1
Oregon.....																			0						0
Pennsylvania (bituminous).....	13	3	10	3		5		1		1	2	1	39					3	42		2				41
South Dakota.....																			0						0
Tennessee.....	3		1										4						4						3
Texas.....																			0						0
Utah.....	1		3										4						0						0
Virginia.....																			0						0
Washington.....			1			3		1					1						2						2
West Virginia.....	13	1	5			3							23						2						25
Wyoming.....	2												3						3						3
Total (bituminous).....	52	10	34	4	1	13		4		1	2	1	122	1		1		14	138	4	3	1	1	5	161
Pennsylvania (anthracite).....	9	7	8	3		2	1					3	33	1			4	10	44	5					55
Total, January, 1919.....	61	17	42	7	1	15	1	4		1	2	4	155	2		1		24	182	9	4	4	1	9	216
Total, January, 1918.....	91	12	33	5	12	12	1	8	2	2	2	10	178	4	2	1	1	29	182	14	5	6	4		216

TABLE 6.—United States: Coal-mine fatalities during February, 1919, by causes and States.

State.	Underground.												Shaft.					Surface.					Total by States.		
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity.	Machinery.	Boiler explosions or bursting steam pipes.		Railway cars and locomotives.	Other causes.
Alabama.....	3	4	1					1					9												9
Alaska.....																									0
Arkansas.....	1												1												1
California, Idaho, and Nevada.....		1											3												0
Colorado.....	2																								0
Georgia and North Carolina.....																									0
Illinois.....	3	2	3			1				1			9	2					2						0
Indiana.....	2												9												0
Iowa.....	3	4	4										2												7
Kansas.....	2												2												3
Kentucky.....	1	4			2								7												4
Maryland.....																									7
Michigan.....																									4
Missouri.....																									1
Montana.....	1	1											2						1						0
New Mexico.....	1												1												0
North Dakota.....		2	2			1				1															0
Ohio.....	5	1	2										12												12
Oklahoma.....																									0
Oregon.....																									0
Pennsylvania (bituminous).....	13	1	6						1				21						1						0
South Dakota.....																								0	
Tennessee.....	2												2												2
Texas.....																									0
Utah.....	2	1				1		1					2												3
Virginia.....																									1
Washington.....	1	1	1										2												4
West Virginia.....	19	1	9					1					30	1					1	1	1				2
Wyoming.....	1	1											3												3
Total (bituminous).....	63	4	30	11	2	3	3	3	3	3	3	2	121	2	1				3	3	1	3			4
Pennsylvania (anthracite).....	11	3	5	2	1						1		23	1	2				3				1		5
Total, February, 1919.....	74	7	35	13	2	4	1	3	3	3	3	3	144	3	3				6	3	1	3			9
Total, February, 1918.....	56	8	40	8	4	17	1	9	1	2	2	2	188	2	3				5	8			6		29

TABLE 7.—United States: Coal-mine fatalities during March, 1919, by causes and States.

State.	Underground.												Shaft.					Surface.					Total by States.			
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity.	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	1919	1918
Alabama.....	2		2					1					5										2		7	5
Alaska.....													1										2		0	0
Arkansas.....					1																				0	0
California, Idaho, and Nevada.....													19												1	0
Colorado.....	2	2	13																						19	8
Georgia and North Carolina.....																									0	0
Illinois.....	14		2		2								18												18	15
Indiana.....	7		1										8												8	8
Iowa.....	1												2												1	3
Kansas.....	1											1	6							1					3	0
Kentucky.....	5					1							2												10	0
Maryland.....																									2	2
Michigan.....	2																								0	0
Missouri.....																									0	0
Montana.....																									0	0
New Mexico.....	2												2												2	0
North Dakota.....	1												1												1	0
Ohio.....	6												6												6	17
Oklahoma.....	1												1												1	3
Oregon.....																									0	0
Pennsylvania (bituminous).....	11	6	9	3				1				1	91			1				1					33	26
South Dakota.....																									0	0
Tennessee.....	2		2										4												2	2
Texas.....																									0	0
Utah.....	2												2												2	1
Virginia.....		1																							1	6
Washington.....																									2	1
West Virginia.....													1												1	0
Wyoming.....	12	2	2							1			17							2					20	33
													1												1	2
Total (bituminous).....	71	11	20	17	3	1	2	2	1	1	3	129	1	1	1	1	8	138	5	1	1	2	148	148		
Pennsylvania (anthracite).....	10	3	6	1		4	2				2	28					5	33							48	48
Total, March, 1919.....	81	14	26	18	3	5	2	3	2	1	5	157	1	1	2	1	13	171	3	1	1	3	171	171		
Total, March, 1918.....	88	8	38	2	21	2	4	4	2	2	9	172	4	2	1	4	15	196	2	4	1	2	196	196		

TABLE 8.—United States; Coal-mine fatalities during April, 1919, by causes and States.

State.	Underground.											Shaft.			Surface.						Total by States.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity.	Machinery.		Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.
Alabama.....	5		3		22						1	31													31
Alaska.....																									0
Arkansas.....																									0
California, Idaho, and Nevada.....																									0
Colorado.....	2	2	1					1				6													0
Georgia and North Carolina.....																									0
Illinois.....	7		3					1				11													1
Indiana.....	2	2	2									4			1										1
Iowa.....	2	2	1									3													6
Kansas.....	2	2										3													3
Kentucky.....	4		2			1						3													3
Maryland.....												3													3
Michigan.....												3													3
Missouri.....												3													3
Montana.....		1										1													0
New Mexico.....		1										1													0
North Dakota.....												7													0
Ohio.....	5		2									2													0
Oklahoma.....			1			1						2													0
Oregon.....												2													0
Pennsylvania (bituminous).....	23	1	4			1				2	1	36							1	1	1				3
South Dakota.....												2													0
Tennessee.....			2									2													0
Texas.....																									0
Utah.....																									0
Virginia.....	1	1	1									1													1
Washington.....	9	1	1									2													2
West Virginia.....	1	1	1								1	12													0
Wyoming.....	2		1									3													0
Total (bituminous).....	64	10	24	5	23	2	2	2	2	2	3	130							5	1	1				7
Pennsylvania (anthracite).....	17	1	8		4	1					3	39	1					3	3	2	1	1			8
Total, April, 1919.....	81	11	32	5	23	6	1	2	2	2	6	169	1					8	2	2	2	1	3	9	15
Total, April, 1918.....	104	9	33	3	6	10		8	2	2	8	185	3	2	1			6	6	1	5	3	24	215	

TABLE 9.—United States: Coal-mine fatalities during May, 1919, by causes and States.

State.	Underground.										Shaft.				Surface.					Total by States.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Electricity.	Machinery.		Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.
Alabama.....	4					2							6											6
Alaska.....														1										0
Arkansas.....	1																							0
California, Idaho, and Nevada.....																								0
Colorado.....								1	1				2											0
Georgia and North Carolina.....																								0
Illinois.....	5		6		5								16	1										17
Indiana.....	5		2										7											7
Iowa.....	1												1											1
Kansas.....	2												3											3
Kentucky.....	2		2		1								3											7
Maryland.....	1							3					11											1
Michigan.....													1											1
Missouri.....																								3
Montana.....		1	1										1											1
New Mexico.....													1											1
North Dakota.....			2										9											0
Ohio.....	7												3											0
Oklahoma.....	3																							3
Oregon.....																								0
Pennsylvania (bituminous).....	19	2	8		3				1	1	1	1	34											35
South Dakota.....																								0
Tennessee.....	1												1											1
Texas.....																								0
Utah.....																								0
Virginia.....																								0
Washington.....																								2
West Virginia.....	13	3	6		1			1	1	1	3		3		1		1	1	1	1	1	1	1	22
Wyoming.....	2				1								3											2
Total (bituminous).....	70	6	27		7	6		5	1	2	4		128	1	2		3	3	1	2	3	9	140	168
Pennsylvania (anthracite).....	16		6								5		38		3		3	1			44	3	44	43
Total May, 1919.....	86	8	33		7	15		5	1	2	9		166	1	5		6	1	3	1	3	4	12	184
Total May, 1918.....	94	14	43	8		7	2	8		1	13	3	193				7	3	3	6	2	6	18	211

TABLE 10.—United States: Coal-mine fatalities during June, 1919, by causes and States.

State.	Underground.											Shaft.				Surface.					Total by States.				
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Electricity.	Machinery.		Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.
Alabama.....	2		1					1					4												4
Alaska.....																									0
Arkansas.....																									0
California, Idaho, and Nevada.....																									1
Colorado.....	1	1	1					2					5												0
Georgia and North Carolina.....																									0
Illinois.....	9	3	4										16												10
Indiana.....	2	1											3	1											0
Iowa.....																									23
Kansas.....																									4
Kentucky.....	3	2				1							1	1											12
Maryland.....																									0
Michigan.....																									2
Missouri.....																									8
Montana.....																									0
New Mexico.....	3	1											4												0
North Dakota.....																									0
Ohio.....	12	2										1	15												15
Oklahoma.....													17												2
Oregon.....																									0
Pennsylvania (bituminous).....	15	1	6							1			23	1						1	2				4
South Dakota.....																									0
Tennessee.....	3												3												28
Texas.....																									0
Utah.....																									0
Virginia.....	1	1								1			1	2											1
Washington.....																									0
West Virginia.....	21	8				2							31												3
Wyoming.....	1			2																					33
Total (bituminous).....	74	3	25	22		1	1	5		2	1	134	1	2					1	2					151
Pennsylvania (anthracite).....	13	10	6	3		97	1	1	1		5	137	1	1					1						144
Total, June, 1919.....	87	13	31	25		98	2	6	1	2	6	271	1	2					1	2					19
Total, June, 1918.....	108	13	44	6		7	2	12	1	1	4	202	2	2					7	2	4				230

TABLE 11.—United States: Coal-mine fatalities during July, 1919, by causes and States.

State.	Underground.										Shaft.				Surface.					Total by States.					
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco- motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Mine cars and mine locomotives.		Electricity.	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.
Alabama.....	1												3						3						3
Alaska.....																									20
Arkansas.....	1												1						1						0
California, Idaho, and Nevada.....																									0
Colorado.....	2	1											3						3						3
Georgia and North Carolina.....																									0
Illinois.....	3	1	3	1		1		2					10			2			2						12
Indiana.....	1	1	1										3						3						3
Iowa.....	2	1	1					1					4						4						4
Kansas.....																									3
Kentucky.....	3	2	2			2		1					8						1						10
Maryland.....													1												1
Michigan.....																									0
Missouri.....																									0
Montana.....	1												1												1
New Mexico.....	4												4												4
North Dakota.....													10												17
Ohio.....	5		4			1							4												4
Oklahoma.....			2					2																	0
Oregon.....																									0
Pennsylvania (bituminous).....	17	1	5			3		1					27	1		1			2	1					32
South Dakota.....																									0
Tennessee.....	2					1							3												4
Texas.....			1																						0
Utah.....	1		2										3												1
Virginia.....	2		2										6												3
Washington.....													2												2
West Virginia.....	21	4	4	6				5					41							3	1				46
Wyoming.....	1	1	1			1							4												4
Total (bituminous)	67	8	26	7		9	2	14		2		3	138	1		3		4	5	1					214
Pennsylvania (anthracite).....	25	3	7	12		5						6	58	2											68
Total, July, 1919	92	11	33	19		14	2	14		2		9	196	3		3		6	10	2					221
Total, July, 1918	136	10	51	12		13	4	10	1	2		5	243	2		1		3	9	3	4	1	5	8	276

TABLE 13.—United States: Coal-mine fatalities during September, 1919, by causes and States.

State.	Underground.										Shaft.				Surface.					Total by States.							
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity.	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.	1919	1918
Alabama.....	1		1										4													4	16
Alaska.....								2																		0	0
Arkansas.....																										0	0
California, Idaho, and Nevada.....																										0	0
Colorado.....	1	1						1					3									1				4	3
Georgia and North Carolina.....																										0	0
Illinois.....	12	3	5	1				3				2	26	1					1							27	38
Indiana.....	2		1			1	1						1			1										9	9
Iowa.....	1		1										1													1	5
Kansas.....													1													2	3
Kentucky.....	7		1										1													9	5
Maryland.....													1													1	0
Michigan.....													1													1	0
Missouri.....	1												1													2	3
Montana.....													1													1	1
New Mexico.....			1										1													1	0
North Dakota.....			1			2							9			1				1						10	14
Ohio.....	7												9													1	1
Oklahoma.....	1												1													4	4
Oregon.....																										0	0
Pennsylvania (bituminous).....	8	6	4			1		2			1	1	22						3				1	5		27	41
South Dakota.....																										0	0
Tennessee.....	1												1													1	1
Texas.....													2													0	0
Utah.....	1					1							2													2	1
Virginia.....													1													0	0
Washington.....													1													2	1
West Virginia.....	18		6					1		2	1	1	26						2			1				31	37
Wyoming.....	2												2													2	2
Total (bituminous).....	65	10	25	1		5	1	9		2	4	122	2	2		2			7		1	1	2			138	198
Pennsylvania (anthracite).....	12	6	6	3		4		1			3	35							1		2					41	32
Total, September, 1919.....	77	16	31	4		9	1	10		2	7	157	2	2		2			8		3	1	1	5		18	179
Total, September, 1918.....	102	7	47	23		12		8		1	11	211	2	2		2			5		1	2	1	2		14	230

TABLE 14.—United States: Coal-mine fatalities during October, 1919, by causes and States.

State.	Underground.										Shaft.			Surface.					Total by States.		
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco- motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.		1919	1918
Alabama.....	4							1		1			6						1	7	16
Alaska.....																				0	0
Arkansas.....																				0	1
California, Idaho, and Nevada.....	3	5	2				1						11						1	12	9
Colorado.....																				0	0
Georgia and North Carolina.....	10		6					2					18	1						0	0
Illinois.....	1	1	1		3								6			2				21	18
Indiana.....																1			1	8	5
Iowa.....																				0	0
Kansas.....	2															2				0	4
Kentucky.....	7	1						1		1			10						1	11	7
Maryland.....	1												1							0	0
Michigan.....																				0	0
Missouri.....	1																			0	0
Montana.....													1							0	2
New Mexico.....			1										1							1	9
North Dakota.....	13		3			4		1			20		41			1				43	10
Ohio.....	2												2							2	2
Oklahoma.....																				0	0
Oregon.....																				0	0
Pennsylvania (bituminous).....	21	4	9	4			3				2		43						1	45	43
South Dakota.....																				0	0
Tennessee.....	1		1										2			2				2	0
Texas.....																				0	0
Utah.....	1	1	1										3							3	2
Virginia.....								1					2							2	2
Washington.....													2							2	0
West Virginia.....	10	1	5	1						1			19						2	2	1
Wyoming.....	4	1											5							24	32
Total (bituminous).....	81	13	30	6		7	1	10		3	20	3	174	1	1	6			8	194	171
Pennsylvania (anthracite).....	18	3	8	5	6					2	2		42						4	7	49
Total, October, 1919.....	99	16	38	11		13	1	10		3	20	5	216	1	1	6			12	243	.....
Total, October, 1918.....	98	13	52	6	1	7		7		1		5	190	2	2	1			19	.....	214

TABLE 15.—United States: Coal-mine fatalities during November, 1919, by causes and States.

State.	Underground.										Shaft.			Surface.					Total by States.						
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and locomotives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Electricity.	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.	1919	1918
Alabama.....	3		1	1									5						1				1	6	3
Alaska.....																								0	0
Arkansas.....																								0	0
California, Idaho, and Nevada.....																								0	0
Colorado.....																								0	0
Georgia and North Carolina.....													3											0	0
Illinois.....	1		2	1									1											3	18
Indiana.....													1											0	1
Iowa.....																								0	1
Kansas.....																								0	0
Kentucky.....	3												3								1		1	4	4
Maryland.....																								0	0
Michigan.....																								0	0
Missouri.....																								0	0
Montana.....																								0	0
New Mexico.....																								0	0
North Dakota.....	1					1							1											1	10
Ohio.....													2											2	0
Oklahoma.....																								0	0
Oregon.....																								0	0
Pennsylvania (bituminous).....	9	2	4					1					16						1					1	0
South Dakota.....																								0	0
Tennessee.....																								0	0
Texas.....																								0	0
Utah.....	2												2											0	25
Virginia.....	1		3										4											2	0
Washington.....																								0	0
West Virginia.....	9		5							1			15											4	1
Wyoming.....	3												3											0	32
Total (bituminous)	33	2	15	2		1		1		1			55						2					58	125
Pennsylvania (anthracite).....	13	6	2	4		5		1				2	33								1		1	3	36
Total, November, 1919	46	8	17	6		6		2		1			88					4	6	1			6	94	157
Total, November, 1918	80	3	35	8	6	4		2		2			141					4	2	2	1		12	157	

TABLE 16.—United States: Coal-mine fatalities during December, 1919, by causes and States.

State.	Underground.										Shaft.			Surface.					Total by States.							
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco- motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity.	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Electricity.	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.	Total.	1919	1918
Alabama.....	4												4												4	7
Alaska.....																									0	0
Arkansas.....	1												1												0	0
California, Idaho, and Nevada.....																									0	0
Colorado.....	4	2											6												1	7
Georgia and North Carolina.....																									0	0
Illinois.....		3	3										6												6	11
Indiana.....	1	2	1	1	10	1						15													15	10
Iowa.....	1	1										1													2	2
Kansas.....	1											1													1	2
Kentucky.....	3	1			1							5													1	3
Maryland.....																									0	0
Michigan.....																									0	0
Missouri.....																									0	0
Montana.....			1									1													1	2
New Mexico.....	2											2													0	0
North Dakota.....																									0	0
Ohio.....	1											1													1	4
Oklahoma.....	2	1						1				4													0	0
Oregon.....																									2	4
Pennsylvania (bituminous).....	12	2	3		1			2		1		1	21												27	27
South Dakota.....																									0	0
Tennessee.....	2	1											3												3	3
Texas.....																									0	0
Utah.....	2	1											2												2	1
Virginia.....	1	2	1					1		1		2	6												6	3
Washington.....													1												1	1
West Virginia.....	12		5		2					1		20													22	34
Wyoming.....	1												1												1	2
Total (bituminous).....	50	9	18	2	11	4		4		1		3	102												9	115
Pennsylvania (anthracite).....	19	6	7	2	5							5	44												10	54
Total, December, 1919.....	69	15	25	4	11	9		4		1		8	146												19	189
Total, December, 1918.....	73	7	44		5	11	4	2				1	150												13	164

DETAILS RELATING TO CHIEF CAUSES OF ACCIDENTS.

The detailed accident report card on which the State mine inspectors report to the bureau makes it possible to present further refinement in the classification of fatalities by principal causes of accidents. The larger groups are further subdivided so that the inspector or operator can determine more nearly the location or the exact cause of the majority of fatalities in these various groups. Table 17 shows the totals for 1916, by subclassification, followed by similar figures for 1917, 1918, and 1919.

TABLE 17.—*Distribution of fatalities by minor causes, 1916 to 1919.*

Cause.	1916	1917	1918	1919
NUMBER KILLED UNDERGROUND.				
1. Falls of roof (coal, rock, etc.):				
(a) At working face.....	670	707	764	641
(b) In room or chamber.....	147	173	179	120
(c) On road, entry, or gangway.....	137	164	225	164
(d) On slope.....	8	8	14	17
2. Falls of face or pillar coal:				
(a) At working face.....	87	151	95	129
(b) On road, entry, or gangway.....	16	22	17	25
3. Mine cars and locomotives:				
(a) Switching and spragging.....	17	6	15	12
(b) Coupling cars.....	12	7	11	6
(c) Falling from trips.....	43	29	36	18
(d) Run over by car or motor.....	147	187	203	146
(e) Caught between car and rib.....	87	122	113	105
(f) Caught between car and roof while riding.....	12	20	27	23
(g) Runaway car or trip.....	42	67	68	42
(h) Miscellaneous.....	30	50	33	26
4. Gas explosions and burning gas:				
(a) Due to open light.....	61	111	55	65
(b) Due to defective safety lamps.....	11	2	2	22
(c) Due to electric arc.....	4	22	3	19
(d) Due to shot.....	5	5	9	6
(e) Due to explosions of powder.....	2	2	3	3
(f) Miscellaneous.....	87	57	23	28
5. Coal-dust explosions (including gas and dust combined):				
(a) Due to open light.....	31	123	2	22
(b) Due to defective safety lamps.....				
(c) Due to electric arc.....			4	
(d) Due to shot.....	22	8	27	24
(e) Due to explosions of powder.....	3	11	1	1
(f) Miscellaneous.....		21		
6. Explosives:				
(a) Transportation.....	21	6	4	97
(b) Charging.....	9	5	13	14
(c) Suffocation.....	7	10	4	3
(d) Drilling into old holes.....	3	1	2	
(e) Striking in loose rock or coal.....			1	
(f) Thawing.....				
(g) Caps, detonators, etc.....	3	2	3	3
(h) Unguarded shots.....		2		3
(i) Returned too soon.....	15	8	18	5
(j) Premature shot.....	58	44	44	56
(k) Sparks from match, lamp, or candle.....	5	5	13	7
(l) Delayed blast.....	11	5	4	2
(m) Shot breaking through rib or pillar.....	7	10	9	6
(n) Miscellaneous.....	7	12	20	10
7. Suffocation from mine gases.....	12	8	15	11
8. Electricity:				
(a) Direct contact with trolley wire.....	66	46	55	39
(b) Bar or tool striking trolley wire.....	5	2	4	2
(c) Contact with mining machine.....	7	5	7	4
(d) Contact with machine feed wire.....	7	16	12	14
(e) Contact with haulage motor.....	1	4	1	2
(f) Miscellaneous.....	4	6	9	8
9. Animals.....	8	9	8	2
10. Mining machines (other than sc).....	20	19	17	26
11. Mine fires (burned, suffocated, etc.).....	3	2	26	22

TABLE 17.—*Distribution of fatalities by minor causes, 1916 to 1919—Continued.*

Cause.	1916	1917	1918	1919
NUMBER KILLED UNDERGROUND—continued.				
12. Other causes:				
(a) Fall of person.....	3	11	5	6
(b) Machinery (other than 10).....	2	2	1	3
(c) Rush of coal or gob.....	21	22	20	15
(d) Falling timber.....	18	12	12	24
(e) Suffocation in chutes.....	1	2	3	2
(f) Hand tools, axes, bars, etc.....				
(g) Nails, splinters, etc.....				1
(h) Miscellaneous.....	22	21	22	19
Total number killed inside of mines.....	2,027	2,375	2,281	2,070
NUMBER KILLED IN SHAFT.				
13. Falling down shafts or slopes.....	31	21	21	20
14. Objects falling down shafts or slopes.....	2	12	9	6
15. Cage, skip, or bucket.....	12	22	17	20
16. Other causes:				
(a) Overwinding.....	1	2		
(b) Breaking of cables.....		2	1	
(c) Miscellaneous.....	3	1	4	6
Total number killed by shaft accidents.....	49	60	52	52
NUMBER KILLED ON SURFACE.				
17. Mine cars and mine locomotives.....	59	74	87	70
18. Electricity.....	7	17	15	10
19. Machinery.....	22	46	40	22
20. Boiler explosions or bursting steam pipes.....	4	8	7	6
21. Railway cars and locomotives.....	16	36	31	21
22. Other causes:				
(a) Explosives.....	2	13	11	1
(b) Fall of person.....	9	19	12	15
(c) Falling objects (derricks, booms, etc.).....	7	7	12	9
(d) Suffocation in chute, bin, or culm.....	6	4	4	3
(e) Falls or slides of rock or coal.....		3	3	10
(f) Steam shovels.....		3	2	2
(g) Hand tools.....				2
(h) Miscellaneous.....	18	31	23	14
Total number killed on surface.....	150	261	247	185
Grand total.....	2,226	2,696	2,580	2,307

TABLE 18.—*Coal-mine fatalities: Percentages by causes, 1914 to 1919.^a*

Cause.	1914	1915	1916	1917 (revised).	1918	1919
Underground:						
Falls of roof (coal, rock, etc.).....	40.14	40.50	43.22	39.21	45.82	40.83
Falls of face or pillar coal.....	5.95	7.05	4.63	6.42	4.34	6.68
Mine cars and locomotives.....	15.48	15.29	17.52	18.10	19.61	16.38
Gas explosions and burning gas.....	13.53	6.74	7.64	7.31	3.68	6.20
Coal-dust explosions (including gas and dust combined).....	.69	6.66	2.51	6.04	1.32	2.04
Explosives.....	5.95	6.83	6.56	4.08	5.23	8.93
Suffocation from mine gases.....	.57	.71	.54	.30	.58	.48
Electricity.....	3.63	3.92	4.04	2.93	3.41	2.99
Animals.....	.29	.13	.26	.33	.31	.09
Mining machines.....	.81	.53	.90	.70	.66	1.13
Mine fires (burned, suffocated, etc.).....	.29	.05	.13	.07	1.01	.95
Other causes.....	2.32	2.78	3.01	2.60	2.44	3.03
Total.....	89.65	91.19	91.06	88.09	88.41	89.73
Shaft:						
Falling down shafts or slopes.....	2.85	1.36	1.39	.78	.81	.86
Objects falling down shafts or slopes.....	.21	.09	.09	.45	.35	.26
Cage, skip, or bucket.....	.49	.31	.54	.82	.66	.86
Other causes.....	.04		.18	.15	.19	.26
Total.....	3.59	1.76	2.20	2.23	2.01	2.25
Surface:						
Mine cars and mine locomotives.....	2.77	2.73	2.65	2.74	3.38	3.03
Electricity.....	.44	.44	.31	.63	.58	.44
Machinery.....	1.06	1.15	.99	1.71	1.55	.95
Boiler explosions or bursting steam pipes.....	.21	.26	.18	.30	.27	.26
Railway cars and locomotives.....	.53	.62	.72	1.33	1.20	.91
Other causes.....	1.75	1.85	1.89	2.97	2.60	2.43
Total.....	6.76	7.05	6.74	9.63	9.58	8.02
Grand total.....	100.00	100.00	100.00	100.00	100.00	100.00

^a Similar data extending from 1913 back to 1870 may be found in Bulletin 115 to which reference has been made on page 5.

PRINCIPAL COAL-MINE DISASTERS.

Table 19 gives a list of mine disasters in the United States for the years 1916, 1917, 1918, and 1919, in each of which there were 5 or more fatalities. During 1918 there were 4 mine disasters in each of which 5 or more men were killed, whereas in 1916 there were 11 such disasters and in 1917 there were 9. The 9 disasters in 1917 killed 262 men, whereas the 4 in 1918 killed 54. The 9 disasters in 1919 killed 201 men.

TABLE 19.—*Coal-mine disasters in the United States in 1916 to 1919, in which 5 or more men were killed.^a*

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1916 Feb. 8	Lance	Plymouth, Pa.	Mine explosion	7
1916 Feb. 11	Jefferson and Clearfield No. 2.	Ernest, Pa.	do.	27
1916 Feb. 29	Davis No. 42	Kempton, W. Va.-Md.	do.	16
1916 Mar. 9	Hollenback	Wilkes-Barre, Pa.	do.	6
1916 Mar. 28	King	Kimball, W. Va.	do.	6
1916 Mar. 30	Robindale	Seward, Pa.	do.	8
1916 Aug. 8	Woodward	Wilkes-Barre, Pa.	do.	6
1916 Oct. 19	Jamison No. 7	Barrackville, W. Va.	do.	10
1916 Oct. 22	Roden	Marvel, Ala.	do.	18
1916 Nov. 4	Bessie	Palos, Ala.	do.	30
1916 Dec. 13	Fidelity No. 9	Stone City, Kans.	do.	29
1917 Mar. 13	Henderson No. 1	Hendersonville, Pa.	do.	14
1917 Apr. 18	Lynden	Mason, W. Va.	Lightning exploded powder in powder house.	5
1917 Apr. 27	Hastings	Hastings, Colo.	Mine explosion	121
1917 June 2	Rend No. 2	Herrin, Ill.	do.	9
1917 Aug. 4	West Kentucky No. 7	Clay, Ky.	do.	62
1917 Nov. 29	Old Ben No. 11	Christopher, Ill.	do.	17
1917 Dec. 15	Yukon No. 1	Bluefield, W. Va.	do.	17
1917 Dec. 17	Wilkeson	Wilkeson, Wash.	Inrush of water and gravel.	6
1917 Dec. 20	Nemo	Harriman, Tenn.	Mine explosion	11
1918 May 20	Villa	Charleston, W. Va.	Mine fire	13
1918 Aug. 7	Harmar	Harmarville, Pa.	Mine explosion	8
1918 Aug. 28	Burnett	Burnett, Wash.	do.	12
1918 Sept. 28	North	Royalton, Ill.	do.	21
1919 Mar. 31	Empire	Aguilar, Colo.	do.	13
1919 Apr. 29	Majestic	Majestic, Ala.	do.	22
1919 June 5	Baltimore tunnel No. 2	Wilkes-Barre, Pa.	Powder explosion	92
1919 June 30	Alderson No. 5	Alderson, Okla.	Mine explosion	15
1919 July 8	Lansford colliery	Lansford, Pa.	Gas explosion	8
1919 July 18	Carswell	Kimball, W. Va.	do.	6
1919 Aug. 6	Weirwood	Weirwood, W. Va.	do.	7
1919 Aug. 18	Oakdale	Laveta, Colo.	do.	13
1919 Oct. 29	Amsterdam No. 2	Amsterdam, Ohio	Mine fire	20

^a Supplemental to Table 44, p. 73, Coal-mine fatalities in the United States, 1870-1914. Bull. 115, Bureau of Mines, 1916.

The following table (20) gives what is believed to be a complete list of those coal-mine disasters in the United States in which 100 or more men were killed:

TABLE 20.—*Coal-mine disasters in the United States in which 100 or more men were killed.*

Date.	Name of mine.	Location of mine.	Nature of accident.	Killed.
1869 Sept. 6	Avondale	Plymouth, Pa.	Mine fire	179
1884 Mar. 13	Laurel	Pocohontas, Va.	Mine explosion	112
1891 Jan. 27	Mammoth	Mount Pleasant, Pa.	do.	109
1892 Jan. 7	No. 11	Krebs, Okla.	do.	100
1900 May 1	Winter quarters Nos. 1 and 4	Seefield, Utah	do.	200
1902 May 19	Fraterville	Coal Creek, Tenn.	do.	184
1902 July 10	Rolling Mill	Johnstown, Pa.	do.	112
1903 June 20	Hanna No. 1	Hanna, Wyo.	Mine explosion and fire	169
1904 Jan. 25	Harwick	Cheswick, Pa.	Mine explosion	179
1905 Feb. 20	Virginia City	Virginia City, Ala.	do.	108
1907 Dec. 6	Monongah Nos. 6 and 8	Monongah, W. Va.	do.	361
1907 Dec. 19	Darr	Jacobs Creek, Pa.	do.	239
1908 Nov. 28	Rachel and Agnes	Marianna, Pa.	do.	154
1909 Nov. 13	St. Paul No. 2	Cherry, Ill.	Mine fire	259
1911 Apr. 8	Banner	Littleton, Ala.	Mine explosion	128
1913 Oct. 22	Stag Canon No. 2	Dawson, N. Mex.	do.	263
1914 Apr. 28	Eccles Nos. 5 and 6	Eccles, W. Va.	do.	181
1915 Mar. 2	Layland No. 3	Layland, W. Va.	do.	112
1917 Apr. 27	Hastings	Hastings, Colo.	do.	121

TABLE 21.—*Production, men employed, and number killed in and about the coal mines in the United States during the year ended Dec. 31, 1914.*

State.	Production (short tons). ^a	Number employed. ^a		Number of days of labor performed.	Average days active. ^a	Number killed.			Number killed per 1,000 employed.		Number killed per 1,000,000 short tons mined.	Production per death (short tons).
		Under- ground.	Surface.			Under- ground.	Surface.	Total.	Under- ground.	Surface.	Total.	
Alabama.....	15,593,422	20,320	3,722	5,433,492	226	127	1	128	6.25	0.27	5.32	121,824
Alaska ^b	13,974	17	26	12,513	291	10	1	11	2.72	1.50	2.54	166,958
Arkansas.....	1,836,540	3,674	665	620,477	143	73	2	75	9.25	.91	7.43	108,941
California, Idaho, and Nevada ^c	8,170,550	7,891	2,207	2,463,912	244	1	1	2	3.64	.....	2.82	166,498
Colorado.....	57,666,498	72,308	7,191	13,783,327	173	184	9	193	2.54	1.25	2.43	298,390
Georgia and North Carolina.....	16,941,132	20,427	2,748	3,893,400	168	42	2	44	2.06	.....	1.90	378,208
Illinois.....	7,431,022	14,232	1,815	3,275,628	204	37	37	74	2.60	.....	2.30	201,379
Iowa.....	6,800,988	10,778	1,670	2,300,016	192	32	1	33	2.97	.60	2.65	4,971
Kansas.....	20,382,763	24,262	4,502	5,378,808	187	55	6	61	2.27	1.33	2.12	207,909
Kentucky.....	4,133,547	4,750	673	1,302,123	241	17	1	18	3.59	1.49	3.33	334,144
Maryland.....	1,263,030	2,234	566	562,800	201	2	.....	2	2.90	.....	.71	229,642
Michigan.....	3,935,980	8,405	1,144	1,706,271	179	19	.....	19	2.26	.....	1.99	641,515
Minnesota.....	2,805,173	3,786	564	1,700,150	203	7	1	8	2.51	1.77	2.39	207,157
Montana.....	3,877,089	3,386	792	1,182,374	289	17	1	18	5.02	1.26	4.31	350,647
New Mexico.....	506,085	407	151	120,528	216	3	.....	3	7.37	.....	5.38	215,427
North Dakota.....	18,843,115	40,438	4,963	4,903,308	108	62	2	64	1.53	.40	1.41	168,895
Ohio.....	3,998,613	6,950	1,128	1,655,990	205	31	.....	31	4.46	.....	4.38	340,424
Oklahoma.....	51,558	132	58	50,540	266	1	.....	1	7.58	.....	3.84	128,665
Oregon.....	147,983,294	162,081	22,120	39,419,014	214	379	23	402	2.34	1.04	2.18	19,401
Pennsylvania (bituminous).....	11,850	31	7	7,144	152	0	.....	0	.....	.....	.....	308,118
South Dakota.....	5,943,258	8,267	1,849	2,225,520	220	24	2	26	2.90	1.08	2.57	228,587
Tennessee.....	2,923,773	4,059	576	1,098,495	237	11	.....	11	2.71	.....	2.37	211,232
Utah.....	3,103,036	2,964	4,112	863,520	210	17	5	22	5.74	4.36	6.36	141,047
Virginia.....	7,959,535	7,587	1,596	2,138,005	235	17	10	27	2.24	6.27	2.94	294,798
Washington.....	3,964,820	4,439	1,366	1,108,755	191	16	1	17	3.60	.73	2.93	180,284
West Virginia.....	71,707,626	66,073	12,890	15,871,563	201	528	28	556	6.99	2.17	7.04	128,971
Wyoming.....	6,476,293	6,862	1,255	1,558,464	192	43	8	51	7.27	6.37	6.28	126,967
Total (bituminous).....	422,703,970	506,025	77,481	113,783,670	195	1,755	104	1,859	3.47	1.34	3.19	4,401
Pennsylvania (anthracite).....	90,821,307	133,309	46,370	44,021,355	245	533	62	595	4.00	1.34	3.31	152,641
Total, 1914.....	513,525,477	639,334	123,851	157,979,295	207	2,288	166	2,454	3.58	1.34	3.22	209,261

^a Data furnished by U. S. Geological Survey.^b Includes California, Idaho, and Nevada.^c Included in Alaska.

TABLE 22.—Production, men employed, and number killed in and about the coal mines in the United States during the year ended Dec. 31, 1915.

State.	Production (short tons). ^a	Number employed. ^a		Average days active.	Number killed.			Number killed per 1,000 employed.		Number killed per 1,000,000 short tons mined.	Production per death (short tons).
		Under- ground.	Surface.		Under- ground.	Surface.	Total.	Under- ground.	Surface.		
Alabama.....	14,927,937	18,984	3,607	22,591	61	2	63	3.21	0.55	4.22	236,951
Alaska ^b	13,937	15	21	c 36			0				
Arkansas.....	1,652,108	3,097	654	3,751	6	2	8	1.94	3.06	4.84	206,513
California, Idaho, and Nevada ^d							0				
Colorado.....	8,624,980	9,890	2,512	12,322	60	3	63	6.09	1.19	5.09	136,904
Georgia and North Carolina.....	8,134,496	9,201	2,727	12,328							
Illinois.....	58,829,576	68,493	7,117	75,610	131	5	136	1.91	.70	1.80	432,370
Indiana.....	17,066,132	20,308	2,469	22,777	43	3	46	2.12	1.22	2.02	369,699
Iowa.....	7,614,145	13,960	1,539	15,549	32	2	34	2.29	1.28	2.19	223,945
Kansas.....	6,824,474	11,412	1,848	13,260	23	1	24	2.02	.51	1.81	352,353
Kentucky.....	21,361,674	23,523	4,437	27,960	61	3	64	2.50	.68	2.29	333,776
Maryland.....	4,180,477	4,977	687	5,664	9	1	10	1.81	1.46	1.77	418,048
Michigan.....	1,156,138	2,237	332	2,569	6	1	7	2.68	3.01	2.72	163,163
Missouri.....	3,811,593	7,614	1,552	9,173	17		17	2.23		1.85	446
Montana.....	2,780,755	2,626	768	3,158	12	1	13	4.57	1.88	4.12	234,211
New Mexico.....	3,847,940	3,437	768	4,205	19		19	5.53		4.52	201,944
Ohio.....	22,434,691	35,813	4,240	40,053	67		67	1.87		1.69	1,891,078
North Dakota.....	3,693,580	7,270	1,187	8,457	17	5	22	2.31	4.21	2.60	334,846
Oklahoma.....	3,393,231	152,086	22,507	174,593			0				167,890
Oregon.....	137,955,137	120	31	151	206					2.77	360,628
Pennsylvania (bituminous).....	5,730,563	15,178	35	15,333	408	30	438	2.68	1.33	2.51	226,214
South Dakota.....	5,730,361	7,510	1,438	8,948			0				2,088,908
Tennessee.....	2,088,908	4,476	5,087	9,563	25		25	3.33		2.79	282,610
Texas.....	3,108,715	2,763	801	3,564	10	1	11	3.02	1.25	3.09	169,221
Utah.....	8,122,595	7,291	1,698	8,989	46	3	49	6.34	1.18	5.36	53,980
Virginia.....	2,429,095	3,785	1,065	4,850	43	2	45	11.10	2.82	9.28	136,243
Washington.....	77,184,069	63,842	12,040	75,882	462	32	494	7.24	2.66	6.51	252,078
West Virginia.....	6,554,028	6,170	1,074	7,244	23	3	26	3.73	2.79	3.59	262,997
Wyoming.....	442,624,426	482,433	45,023	527,456	1,583	100	1,683	3.28	1.33	3.02	151,860
Total (bituminous).....	88,965,061	130,963	43,589	176,592	526	60	586	4.02	1.32	6.58	234,297
Pennsylvania (anthracite).....											
Total, 1915.....	531,619,487	613,396	120,612	734,008	2,109	160	2,269	3.44	1.33	4.27	

^a Data furnished by U. S. Geological Survey.^b Includes California, Idaho, and Nevada.^c Does not include Alaska.^d Included in Alaska.

TABLE 23.—Production, men employed, and number killed in and about the coal mines in the United States during the year ended Dec. 31, 1916.

State.	Production (short tons). ^a	Number employed. ^a			Number killed.			Number killed per 1,000 employed.			Production per 1,000,000 short tons mined.
		Under- ground.	Surface.	Total.	Under- ground.	Surface.	Total.	Under- ground.	Surface.	Total.	
Alabama.....	18,086,197	21,453	3,855	25,308	116	3	119	5.41	0.78	4.70	151,985
Alaska.....	13,073	69	14	83	179		0	2.29		1.86	284,988
Arkansas.....	1,991,915	3,065	717	3,782	7		7				218,819
California, Idaho, and Nevada.....	7,240	11	7	18	188		0				517,554
Colorado.....	10,484,287	10,456	2,648	13,104	233	39	4	3.73	1.51	3.28	383,991
Georgia and North Carolina.....	173,554	322	89	411	128		1	1.88	11.24	1.69	241,219
Illinois.....	66,195,336	68,127	7,411	75,538	198		1	2.33	.67	2.15	127,434
Indiana.....	20,063,528	20,992	2,973	23,965	187	2	2	5.13	1.35	4.45	338,387
Iowa.....	7,260,800	12,900	1,483	14,383	202	29	31	2.58	2.54	5.68	139,376
Kansas.....	6,881,455	10,325	1,407	12,132	204	63	12	6.57	1.09	.79	590,180
Kentucky.....	25,393,997	26,501	4,721	31,222	208		1	.91		4.23	700,358
Maryland.....	4,400,046	4,719	911	5,630	256	31	2	5.22		4.20	227,033
Michigan.....	1,400,360	2,124	411	2,535	216		2	5.75		1.40	158,634,912
Minnesota.....	4,742,146	7,877	1,777	9,654	16		6	1.81	.64	3.33	138,770
Montana.....	3,632,527	3,065	1,710	4,775	207		16	2.95	.79	2.57	393,292
New Mexico.....	3,793,010	3,304	1,218	4,522	242		19			1.63	408,163
North Dakota.....	34,684,912	36,583	101	36,684	19		16	2.45	4.10	4.45	983,752
Ohio.....	34,728,219	36,680	4,714	41,394	244		19	6.45	6.45	7.35	155,106
Oklahoma.....	3,408,011	6,620	1,180	7,800	105	3	108	8.33	.83	5.42	183,106
Oregon.....	42,392	78	28	106	26		26	1.81	1.78	4.38	144,695
Pennsylvania (bituminous).....	170,295,424	139,186	29,026	168,212	410	23	433	3.84	1.78	4.77	232,420
South Dakota.....	8,886	26	12	38	15		0	2.95	.82	4.14	263,688
Tennessee.....	6,137,440	7,601	1,550	9,151	15		15	1.96		2.98	300,730
Texas.....	1,987,503	3,901	580	4,481	239		2	5.34		3.47	157,799
Utah.....	3,567,428	2,397	732	3,129	20	3	23	8.33	4.10	1.53	
Virginia.....	9,707,474	7,359	2,418	9,777	228		53	6.33	.83	1.15	
Washington.....	3,038,588	3,761	1,033	4,794	272	51	2	5.05		3.09	
West Virginia.....	86,460,127	64,618	13,449	78,067	318	21	372	5.39	1.78		
Wyoming.....	7,910,617	6,011	1,214	7,225	29		30	4.80			
Total (bituminous).....	502,519,682	474,244	86,858	561,102	230	84	1,671	3.35	.97	2.98	
Pennsylvania (anthracite).....	87,578,193	116,705	43,164	159,869	1,489	66	1,555	4.19	1.53	3.47	
Total, 1916.....	590,098,175	590,949	130,022	720,971	2,076	150	2,226	3.51	1.15	3.09	265,094

^a Data furnished by U. S. Geological Survey.

TABLE 24.—Production, men employed, and number killed in and about the coal mines in the United States during the year ended Dec. 31, 1917.

State.	Production (short tons). ^a	Number employed. ^a		Number of days of labor performed. ^a	Average days active. ^a	Number killed.		Number killed per 1,000 employed.		Number killed per 1,000,000 short tons mined.	Produc- tion per death (short tons).
		Under- ground.	Surface.			Under- ground.	Surface.	Under- ground.	Surface.		
Alabama.....	20,008,074	22,025	5,461	7,741,017	273	100	8	4.30	1.40	5.38	185,816
Alaska.....	63,955	(6)	(b)	747,959	187	17	—	5.42	—	7.93	126,083
Arkansas.....	2,143,579	3,135	863	2,940	173	—	—	—	—	—	—
California, Idaho, and Nevada.....	6,423	11	6	3,743,539	263	184	4	16.30	1.36	13.21	66,401
Colorado.....	12,467,326	11,285	2,946	75,640	209	—	—	—	—	15.06	110,028
Georgia and North Carolina.....	86,199,387	75,005	9,005	20,414,269	343	215	18	2.86	2.00	2.77	309,954
Illinois.....	26,539,329	22,684	3,854	5,800,245	221	75	1	3.31	.26	2.86	349,202
Indiana.....	8,905,830	12,672	1,594	3,584,279	251	34	2	2.68	1.25	2.52	240,051
Iowa.....	7,184,975	8,816	1,864	2,304,508	216	29	2	3.20	.54	2.81	239,499
Kansas.....	27,807,971	28,102	6,761	7,472,872	214	131	11	4.65	1.03	5.11	195,831
Kentucky.....	4,745,924	4,696	1,223	1,504,209	254	20	1	4.26	.82	4.42	225,986
Maryland.....	1,374,865	2,154	252	611,474	254	2	2	4.93	7.94	2.91	343,701
Michigan.....	5,070,549	7,680	1,988	2,318,083	240	11	—	1.43	—	1.14	514,504
Missouri.....	4,226,689	3,338	811	1,110,172	268	21	2	6.20	2.47	5.44	183,769
Montana.....	4,040,527	3,191	935	1,326,041	321	16	—	5.01	—	4.00	280,033
New Mexico.....	700,548	610	202	1,300,003	255	3	—	4.85	—	3.70	263,516
North Dakota.....	40,738,734	38,500	6,940	9,575,979	210	104	4	2.70	.58	2.65	377,303
Ohio.....	4,386,844	7,017	1,478	1,705,008	211	36	1	5.13	.08	8.43	118,563
Oklahoma.....	28,327	57	27	26,078	251	—	—	—	—	—	—
Oregon.....	172,448,142	143,087	30,281	45,458,083	261	453	42	3.15	1.39	2.87	348,390
Pennsylvania (bituminous).....	8,042	34	34	5,208	151	—	—	—	—	—	—
South Dakota.....	6,194,221	8,063	2,308	2,510,011	241	27	1	3.35	.42	4.52	221,222
Tennessee.....	2,355,815	3,083	692	1,190,805	313	—	—	—	—	4.42	2,355,815
Texas.....	4,125,210	2,500	916	7,763,751	313	17	5	6.02	5.40	5.35	187,310
Utah.....	10,087,001	8,007	2,081	3,045,685	273	59	4	6.85	1.36	6.25	160,113
Virginia.....	4,009,992	4,072	1,240	1,440,240	271	27	3	6.63	2.42	7.48	133,663
Washington.....	86,441,667	69,155	19,267	19,888,728	225	329	53	4.76	2.85	4.44	225,109
West Virginia.....	8,575,619	6,024	1,334	1,812,010	240	36	1	5.98	.75	4.31	231,773
Wyoming.....	—	—	—	—	—	—	—	—	—	—	—
Total (bituminous).....	551,790,563	498,185	104,958	146,499,420	243	1,948	166	3.91	1.58	3.83	261,017
Pennsylvania (anthracite).....	99,611,811	109,989	44,185	43,900,254	285	483	99	4.39	2.24	5.84	171,154
Total, 1917.....	651,402,374	608,174	149,143	190,399,680	251	2,431	265	4.00	1.78	4.14	241,618

^a Data furnished by the U. S. Geological Survey.^b Not available.

TABLE 25.—Production, men employed, and number killed in and about the coal mines in the United States during the year ended Dec. 31, 1918.

State.	Production (short tons). ^a	Number employed. ^a		Average days of labor performed. ^a	Number killed.			Number killed per 1,000 employed.		Number killed per 1,000,000 tons mined.	Produc- tion per 1,000,000 short tons.
		Under- ground.	Surface.		Under- ground.	Surface.	Total.	Under- ground.	Surface.		
Alabama.....	19,184,962	20,284	5,637	26,221	107	3	110	5.20	0.53	4.20	171,409
Alaska.....	75,606	170	69	239	.....	.....	.....	.....	.....	5.73	.....
Arizona.....	2,227,369	3,107	871	3,978	13	.....	13	4.18	.....	3.27	171,336
California, Idaho, and Nevada.....	6,000	10	5	15	.....	.....	.....	.....	.....	5.84	.....
Colorado.....	12,407,571	11,320	3,168	14,483	69	2	71	6.10	.63	4.90	174,755
Georgia and North Carolina.....	89,291,105	75,270	10,685	85,955	237	1	238	5.88	14.29	8.33	31,068
Illinois.....	30,678,634	23,979	6,397	30,376	35	5	40	3.15	.78	2.27	275,173
Indiana.....	8,192,195	11,774	1,554	13,328	30	1	31	3.96	.64	3.28	306,786
Iowa.....	7,561,947	8,652	2,013	10,665	29	3	32	3.35	1.49	3.00	261,264
Kansas.....	31,612,617	30,323	9,019	39,342	17	8	25	2.88	.89	3.00	236,311
Kentucky.....	4,497,297	4,377	1,151	5,528	19	.....	19	3.88	.....	1.96	110,553
Maryland.....	1,464,818	2,207	351	2,558	17	.....	17	4.53	.....	3.05	264,537
Michigan.....	5,667,730	7,644	1,946	9,590	13	2	15	4.53	5.70	4.69	364,537
Missouri.....	4,532,505	3,347	1,212	4,559	13	.....	13	1.70	.....	1.36	122,068
Montana.....	4,023,239	2,971	1,124	4,095	29	3	32	4.18	2.48	3.73	135,979
New Mexico.....	719,733	602	226	828	29	2	31	9.76	1.78	7.57	266,618
North Dakota.....	45,842,943	39,883	8,587	48,450	136	13	149	3.41	1.52	3.08	129,782
Ohio.....	4,813,447	7,057	1,394	8,451	30	1	31	4.25	.72	3.67	307,469
Oklahoma.....	13,328	25	15	40	.....	.....	.....	.....	.....	6.44	155,272
Oregon.....	178,550,741	140,502	33,804	174,306	448	43	491	3.19	1.27	2.82	363,647
Pennsylvania (bituminous).....	7,912	21	21	42	.....	.....	.....	.....	.....	2.75	.....
South Dakota.....	6,831,048	8,198	2,496	10,694	14	.....	14	1.71	.....	2.05	487,932
Tennessee.....	2,261,135	3,391	545	3,936	7	.....	7	2.06	.....	1.78	323,019
Texas.....	5,136,825	3,065	1,095	4,160	15	4	19	4.89	3.65	3.70	239,298
Utah.....	10,280,808	8,788	2,216	11,004	41	4	45	4.67	1.90	4.18	270,360
Virginia.....	4,082,212	3,836	1,273	5,109	31	2	33	8.08	1.57	6.46	123,703
Washington.....	89,985,839	69,047	20,153	89,200	386	51	437	5.59	2.49	4.86	205,803
West Virginia.....	94,483,688	5,332	1,622	6,954	39	2	41	6.57	1.23	5.43	230,212
Wyoming.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.34	.....
Total (bituminous).....	579,385,820	496,252	119,053	615,305	1,980	149	2,029	3.79	1.25	3.30	285,552
Pennsylvania (anthracite).....	98,826,084	101,671	45,450	147,121	453	98	551	4.46	2.16	3.75	179,358
Total, 1918.....	678,211,904	597,923	164,503	762,426	2,333	247	2,580	3.90	1.50	3.38	262,873

^a Data furnished by the U. S. Geological Survey.

FATALITY RATES ON A 2,000-HOUR BASIS, 1914 TO 1918.

In comparing mine accidents, the duration of the miner's exposure to mine hazards should be considered. This period varies in different States, owing to commercial requirements and labor conditions. The number of hours worked per day is largely regulated by labor organizations and by State laws, and the number of days worked per year is regulated by labor and market conditions. When the demand for coal is light, the output is curtailed by working part time or by closing the mines entirely pending a better market.

Obviously it is not fair to compare the fatality rate of an 8-hour State with that of a 10-hour State, using as a basis the actual number of men employed, when the men in the latter State are exposed to the mining risk 25 per cent longer. Every hour adds $12\frac{1}{2}$ per cent to the hazard as compared with an 8-hour day.

The number of hours per year is based on the reports rendered by operators to the United States Geological Survey, wherein the number of 8, 9, and 10-hour workers is reported. As regards the actual number of working hours, it should be remembered that the length of the day, as stated, refers to the number of hours that that mine is supposed to be in operation and not to the number of hours actually worked by the miners. Much coal is mined by contract at a stated price per ton, so that it is practically impossible to obtain the exact number of hours worked by the individual miner, though such information is highly desirable. The best that can be had is an approximation on the above basis. Tables 26, 27, and 28, published herewith, present data of this character for 1914 to 1918. Table 31 gives the number of 9 and 10-hour men, 1914 to 1918, inclusive, by States, and is used as a basis upon which the above-mentioned tables are calculated. Similar data extending back to 1903 may be found in Tables 40 and 41, Bulletin 115,^a while under the various States will be found labor data, by days, hours, etc., for 1903 to 1913, inclusive, similar to that shown in Table 31, in which page references are given.

^a Fay, A. H., Coal-mine fatalities in the United States, 1870-1914. Bull. 115, Bureau of Mines, 1916, pp. 61-62.

TABLE 26.—Men employed, hours worked, and fatality rates, at coal mines, during the years ended Dec. 31, 1914 and 1915.^a

State.	Men employed.	Average days worked.	Total hours worked (all employees).		Number of 2,000-hour workers.	Fatalities.	
			Per day.	Per year.		Total.	Per 1,000-2,000-hour workers.
1	2	3	4	5	6	7	
Alabama.....	24,042	226	233,037	52,666,362	26,333	128	4.86
Alaska ^b	43	291	387	112,617	56	0	.....
Arkansas.....	4,339	143	34,737	4,967,391	2,484	11	4.43
California, Idaho, and Nevada ^c							
Colorado.....	10,098	244	81,441	19,871,604	9,936	75	7.55
Georgia and North Carolina.....	355	207	3,195	661,365	331	1	3.02
Illinois.....	79,499	173	636,819	110,169,687	55,085	191	3.50
Indiana.....	23,175	168	187,488	31,497,984	15,749	44	2.79
Iowa.....	16,057	204	129,003	26,816,612	13,158	37	2.81
Kansas.....	12,448	192	99,792	19,160,064	9,580	25	3.44
Kentucky.....	28,764	187	270,558	50,594,346	25,297	61	2.41
Maryland.....	5,408	241	53,833	12,973,753	6,487	18	2.77
Michigan.....	2,800	201	23,130	4,649,130	2,325	2	2.86
Missouri.....	9,549	179	76,608	13,712,832	6,856	19	2.77
Montana.....	3,350	209	26,957	5,634,013	2,817	8	2.84
New Mexico.....	4,178	283	33,817	9,570,211	4,785	18	3.76
North Dakota.....	558	216	5,374	1,160,784	580	3	5.17
Ohio.....	45,401	108	364,910	39,410,240	19,705	64	3.25
Oklahoma.....	8,078	205	64,970	13,318,850	6,659	31	4.66
Oregon.....	190	266	1,741	463,106	232	1	4.31
Pennsylvania (bituminous).....	184,201	214	1,599,161	342,220,454	171,110	402	2.35
South Dakota.....	47	152	423	64,296	32	0	.....
Tennessee.....	10,116	220	93,930	20,664,600	10,332	25	2.52
Texas.....	4,635	237	40,237	9,536,169	4,768	11	2.31
Utah.....	4,112	210	32,896	6,908,160	3,454	22	6.37
Virginia.....	9,183	235	90,336	21,228,960	10,614	27	2.54
Washington.....	5,805	191	46,528	8,886,848	4,443	17	3.83
West Virginia.....	78,963	201	745,349	149,815,149	74,908	556	7.42
Wyoming.....	8,117	192	65,349	12,547,008	6,274	51	8.13
Total (bituminous) ^d	583,506	195	5,042,006	982,529,145	491,265	1,859	3.73
Pennsylvania (anthracite).....	179,679	245	1,617,111	396,192,195	198,096	595	3.00
Total, 1914 ^d	763,185	207	6,659,117	1,378,437,219	689,219	2,454	3.56
1915.							
Alabama.....	22,591	223	220,059	49,073,157	24,537	63	2.57
Alaska (not reported).....							
Arkansas.....	3,751	149	30,170	4,495,330	2,248	8	3.50
California, Idaho, and Nevada.....	36	285	324	92,340	46	0	.....
Colorado.....	12,372	194	99,089	19,223,266	9,612	83	6.55
Georgia and North Carolina.....	368	197	3,312	652,464	326	0	.....
Illinois.....	75,610	179	605,871	108,450,909	54,225	136	2.51
Indiana.....	22,777	179	182,698	32,702,942	16,351	46	2.81
Iowa.....	15,549	220	124,633	27,419,260	13,710	34	2.48
Kansas.....	13,260	154	106,470	19,590,480	9,795	24	2.45
Kentucky.....	27,960	186	261,184	48,580,224	24,290	64	2.63
Maryland.....	5,664	242	56,088	13,573,296	6,787	10	1.47
Michigan.....	2,569	198	20,552	4,069,296	2,035	7	3.44
Missouri.....	9,173	146	73,689	13,706,154	6,853	17	2.48
Montana.....	3,158	201	25,314	5,088,114	2,544	13	6.11
New Mexico.....	4,205	262	33,811	8,858,482	4,429	19	4.29
North Dakota.....	590	219	5,705	1,249,395	625	1	1.60
Ohio.....	40,053	142	322,087	45,736,354	22,868	67	2.93
Oklahoma.....	8,457	167	68,329	11,410,943	5,705	22	3.86
Oregon.....	151	206	1,267	261,002	131	0	.....
Pennsylvania (bituminous).....	174,593	226	1,520,984	343,742,384	171,871	438	2.55
South Dakota.....	35	155	315	48,825	24	0	.....
Tennessee.....	8,948	220	82,997	18,259,340	9,130	25	2.74
Texas.....	5,087	233	44,306	10,323,298	5,162	1	1.19
Utah.....	3,564	208	28,520	5,932,160	2,966	11	3.71
Virginia.....	8,959	235	89,390	21,006,650	10,503	48	4.57
Washington.....	4,850	169	38,841	6,564,129	3,282	46	14.02
West Virginia.....	75,882	208	715,093	148,739,344	74,370	494	6.64
Wyoming.....	7,244	201	57,966	11,651,166	5,826	26	4.46
Total (bituminous) ^d	557,456	203	4,819,064	977,467,939	488,734	1,683	3.44
Pennsylvania (anthracite).....	176,552	230	1,588,968	365,462,640	182,731	558	3.21
Total, 1915 ^d	734,008	209	6,408,032	1,339,278,688	669,639	2,269	3.39

^a Compiled from Mineral Resources, U. S. Geological Survey.^b Includes California, Idaho, and Nevada.^c Included in Alaska.^d Totals in columns 4 and 5 obtained by calculating averages for United States, and not by adding corresponding figures for each State.

TABLE 27.—Men employed, hours worked, and fatality rates, at coal mines, during the years ended Dec. 31, 1916 and 1917.^a

1916.							
State.	Men employed.	Average days worked.	Total hours worked (all employees).		Number of 2,000-hour workers.	Fatalities.	
			Per day.	Per year.		Total.	Per 1,000-2,000-hour workers.
Alabama.....	25,308	262	247,842	64,934,604	32,467	119	3.67
Alaska.....	83	179	747	133,713	67	0	.....
Arkansas.....	3,772	184	30,320	5,578,880	2,789	7	2.51
California, Idaho, and Nevada.....	18	188	162	30,456	15	0	.....
Colorado.....	13,104	233	105,396	24,557,268	12,279	82	3.50
Georgia and North Carolina.....	411	280	3,699	1,035,720	518	1	1.93
Illinois.....	75,538	198	605,143	119,818,314	59,909	122	2.14
Indiana.....	23,965	187	192,859	36,064,633	18,032	51	2.83
Iowa.....	14,443	202	116,429	23,518,658	11,759	81	2.64
Kansas.....	12,132	204	97,666	19,923,864	9,962	54	5.42
Kentucky.....	31,222	208	291,957	60,727,056	30,364	75	2.47
Maryland.....	5,633	256	56,084	14,357,504	7,179	32	4.46
Michigan.....	2,535	216	20,280	4,380,480	2,190	2	.91
Missouri.....	9,654	207	77,638	16,071,066	8,036	6	.75
Montana.....	3,781	244	30,253	7,381,732	3,691	16	4.33
New Mexico.....	4,522	292	37,810	11,040,520	5,320	19	3.44
North Dakota.....	714	244	6,893	1,681,892	841	1	1.19
Ohio.....	41,394	197	332,524	65,507,228	32,754	105	3.20
Oklahoma.....	7,800	178	62,760	11,171,280	5,586	26	4.65
Oregon.....	106	236	895	211,220	106	3	28.30
Pennsylvania (bituminous).....	168,212	259	1,466,532	379,844,738	189,922	433	2.28
South Dakota.....	38	145	342	49,590	25	0	.....
Tennessee.....	9,211	239	86,044	20,564,516	10,282	15	1.46
Texas.....	4,481	218	38,916	8,483,688	4,242	2	.47
Utah.....	8,129	228	25,110	5,725,080	2,863	23	8.03
Virginia.....	9,777	272	97,482	26,515,104	13,258	53	4.00
Washington.....	4,797	217	38,880	8,328,460	4,164	21	5.04
West Virginia.....	78,067	237	734,532	174,084,084	87,042	372	4.27
Wyoming.....	7,255	248	58,413	14,486,424	7,243	30	4.14
Total (bituminous) ^b	561,102	230	4,863,158	1,117,387,840	558,694	1,671	2.99
Pennsylvania (anthracite).....	159,869	253	1,318,919	333,686,507	166,843	555	3.33
Total, 1916 ^b	720,971	235	6,182,077	1,452,788,095	726,394	2,226	3.06
1917.							
Alabama.....	28,386	273	272,654	74,434,542	37,217	103	2.90
Alaska.....	.....	.....	.....	.....	.....	.....	.....
Arkansas.....	3,998	187	32,349	6,049,263	3,025	17	5.62
California, Idaho, and Nevada.....	17	173	153	26,469	13	.....	.....
Colorado.....	14,231	263	115,841	30,466,183	15,233	188	12.34
Georgia and North Carolina.....	281	269	2,529	680,301	340	1	2.94
Illinois.....	84,090	243	674,375	163,873,125	81,937	233	2.84
Indiana.....	26,528	221	214,458	47,395,218	28,698	76	3.21
Iowa.....	14,266	251	115,966	28,681,566	14,441	39	2.49
Kansas.....	10,680	216	85,976	18,570,816	9,285	30	3.23
Kentucky.....	34,926	214	301,429	64,505,806	32,253	142	4.40
Maryland.....	5,919	254	48,864	12,411,456	6,206	21	3.38
Michigan.....	2,406	254	19,279	4,896,866	2,448	4	1.63
Missouri.....	9,668	240	77,896	18,695,040	9,348	11	1.18
Montana.....	4,149	268	33,236	8,907,248	4,454	23	5.16
New Mexico.....	4,126	321	34,517	11,079,957	5,540	16	2.89
North Dakota.....	821	255	7,600	1,938,000	969	3	3.10
Ohio.....	45,509	210	366,639	76,994,190	38,497	108	2.81
Oklahoma.....	8,495	211	68,621	14,479,021	7,240	37	5.11
Oregon.....	104	251	866	217,366	109	.....	.....
Pennsylvania (bituminous).....	173,968	261	1,447,023	377,673,003	188,837	495	2.62
South Dakota.....	34	154	306	47,124	24	.....	.....
Tennessee.....	10,421	241	92,698	22,340,218	11,170	28	2.51
Texas.....	4,375	263	38,108	10,022,404	5,011	1	.20
Utah.....	3,485	219	27,948	6,120,612	3,060	22	7.19
Virginia.....	11,168	273	103,188	28,170,324	14,085	63	4.47
Washington.....	5,312	271	42,723	11,577,983	5,789	30	5.18
West Virginia.....	88,422	225	761,725	171,388,125	85,694	354	4.48
Wyoming.....	7,358	246	58,882	14,454,972	7,242	37	5.11
Total (bituminous) ^b	603,143	243	5,044,949	1,225,922,607	612,961	2,114	3.45
Pennsylvania (anthracite).....	154,174	285	1,233,392	351,516,720	175,758	582	3.31
Total, 1917 ^b	757,317	251	6,278,341	1,575,863,591	787,932	2,696	3.42

^a Compiled from Mineral Resources, U. S. Geological Survey.^b Totals in columns 4 and 5 obtained by calculating averages for United States, and not by adding corresponding figures for each State.

TABLE 28.—*Men employed, hours worked, and fatality rates, at coal mines, during the year ended Dec. 31, 1918.^a*

State.	Men employed.	Average days worked.	Total hours worked (all employees).		Number of 2,000-hour workers.	Fatalities.	
			Per day.	Per year.		Total.	Per 1,000-2,000-hour workers.
	1	2	3	4	5	6	7
Alabama.....	26,221	278	212,732	59,139,496	29,570	110	3.72
Alaska.....	239	254	2,151	546,354	273		
Arkansas.....	3,978	204	32,399	6,609,396	3,305	13	3.93
California, Idaho, and Nevada.....	15	240	135	32,400	16		
Colorado.....	14,483	255	116,608	29,735,040	14,868	71	4.78
Georgia and North Carolina.....	240	212	2,160	457,920	229	2	8.73
Illinois.....	85,965	238	688,365	163,830,870	81,915	238	2.91
Indiana.....	30,376	227	244,772	55,563,244	27,782	100	3.60
Iowa.....	13,328	245	107,710	26,388,950	13,194	31	2.35
Kansas.....	10,665	234	86,313	20,197,242	10,099	32	3.17
Kentucky.....	39,342	230	331,840	76,323,200	38,162	77	2.02
Maryland.....	5,568	261	44,778	11,687,058	5,844	17	2.91
Michigan.....	2,558	237	20,496	4,857,552	2,429	12	4.94
Missouri.....	9,590	235	77,656	18,249,160	9,125	13	1.42
Montana.....	4,559	264	36,569	9,654,216	4,827	17	3.52
New Mexico.....	4,095	301	32,832	9,882,432	4,941	31	6.27
North Dakota.....	828	229	7,130	1,632,770	816		
Ohio.....	48,450	223	390,511	87,083,953	43,542	149	3.42
Oklahoma.....	8,451	228	68,292	15,570,576	7,785	31	3.98
Oregon.....	40	292	330	96,360	48		
Pennsylvania (bituminous).....	174,306	269	1,421,366	382,347,454	191,174	491	2.57
South Dakota.....	21	145	189	27,405	14		
Tennessee.....	10,694	265	88,715	23,509,475	11,755	14	1.19
Texas.....	3,936	262	33,927	8,888,874	4,444	7	1.58
Utah.....	4,160	258	33,329	8,598,882	4,299	19	4.42
Virginia.....	11,004	277	90,634	25,105,618	12,553	43	3.43
Washington.....	5,109	275	40,911	11,250,525	5,625	33	5.87
West Virginia.....	89,530	238	750,373	178,588,774	89,294	437	4.89
Wyoming.....	7,554	268	60,792	16,292,256	8,146	41	5.03
Total (bituminous) ^b.....	615,305	249	5,024,015	1,250,979,735	625,490	2,023	3.24
Pennsylvania (anthracite).....	147,121	293	1,176,968	344,851,624	172,426	551	3.20
Total, 1918 ^b.....	762,426	258	6,200,983	1,599,853,614	799,927	2,580	3.23

^a Compiled from Mineral Resources, U. S. Geological Survey.^b Totals in columns 4 and 5 obtained by calculating averages for United States, and not by adding corresponding figures for each State.

STATISTICS OF COAL PRODUCTION BY STATES, 1914 TO 1918.

Table 29 shows the production of coal by States, the value per ton, number of men employed, number killed, and the production per man per day per year. This table supplements similar tables in Bulletin 115 to which reference is made by numbers in parenthesis following the name of each State.

STATE MINE FATALITIES BY CAUSES AND STATES, 1914 TO 1919.

Table 30 shows the fatalities by causes and by States from 1914 to 1919, inclusive, and is supplemental to similar tables published in Bulletin 115 to which reference is made by figures in parenthesis following the name of each State. The data tabulated herewith in connection with that shown in Bulletin 115 shows the mine fatality record by causes in States back to the beginning of inspection in each State.

TABLE 29.—Production, number of men employed, and number of men killed in and about the coal mines in the United States, by calendar years; also tonnage mined per man, as well as the number and kind of mining machines in use.

(The number in parentheses after each State refers to a like State table bearing the same number in Bulletin 115.)

State and year.	Production (short tons). ^a	Value per ton at mine. ^a	Number employed. ^a	Number killed.				Production per death (short tons).	Days worked. ^a	Average tonnage per man. ^a				Percentage coal mined by— ^a				Number and kind of machines. ^a						Number of mines. ^a
				Total.			Per 1,000 em- ployed.			Per 1,000,000 tons mined.	Per year.	Per day.	Hand.	Machine.	Shot off solid.	Not reported. ^b	Pick.	Chain breast.	Long wall.	Short wall.	Radial ax or post.	Total.		
				4	5	6																	7		8	9	10	11	12	13	14	15	16	17	18	19	20	21
Alabama (85):																								
1914.....	15,593,422	1.34	24,042	128	5.32	8.21	121,824	226	619	2.87	32.9	31.7	35.3	0.1	223	31	20	88		362	207			
1915.....	14,927,937	1.28	22,591	63	2.79	4.22	236,951	223	661	2.96	31.0	35.4	33.5	.1						373				
1916.....	18,085,197	1.37	25,308	119	4.70	6.58	151,985	262	715	2.73	31.3	32.1	36.2	.4						320				
1917.....	20,088,074	2.27	28,386	108	3.80	5.38	185,816	273	707	2.69										332				
1918.....	19,184,962	2.85	26,221	110	4.20	5.73	174,109	278	732	2.63	22.1	31.0	44.3	2.6						403				
Alaska:																								
1914c.....	13,974	2.85	43	0				291	325	1.11					2					2				
1915.....	1,400	2.36		0																				
1916.....	13,073	4.00	83	0				179																
1917.....	53,953	4.92		0																				
1918.....	75,006	5.45	239	0				254																
Arkansas (87):																								
1914.....	1,836,540	1.72	4,339	11	2.54	5.99	168,958	143	423	2.96	2.9	19.1	77.9	.1				28		28	56			
1915.....	1,652,106	1.79	3,751	8	2.13	4.84	206,513	149	440	2.95	.4	23.7	75.4	.5				24		24				
1916.....	1,994,915	1.92	3,772	7	1.86	3.51	284,988	184	528	2.87	6.7	11.2	81.6	.5				20		20				
1917.....	2,143,579	2.56	3,908	17	4.25	7.93	126,093	187	536	2.87								18		18				
1918.....	2,227,369	3.67	3,978	13	3.27	5.84	171,336	204	590	2.75	6.3	10.9	77.5	5.2				24		24				
California (89), Idaho and Nevada:																								
1914d.....				0																				
1915.....	12,593	2.56	36	0				285											3					
1916.....	7,240	2.12	18	0				188																
1917.....	6,423	2.30	17	0				173																
1918.....	6,400	2.70	15	0				240																
Colorado (91):																								
1914.....	8,170,559	1.66	10,008	75	7.43	9.18	108,941	244	803	3.32	57.3	30.6	11.6	.5	168	35	11	87	5	306	103			
1915.....	8,624,980	1.58	12,372	43	5.09	7.30	136,901	194	607	3.00	57.8	30.5	11.3	.4						299				
1916.....	10,481,297	1.62	13,104	43	3.28	4.10	243,819	233	800	3.43	51.4	31.9	16.1	.6						305				
1917.....	12,483,396	2.22	14,231	188	13.21	15.06	66,401	263	877	3.33										328				
1918.....	12,407,571	2.69	14,483	71	4.90	5.72	174,755	265	857	3.36	51.0	36.9	7.3	1.8						352				

^a Data furnished by U. S. Geological Survey. ^b Since 1915 includes coal mined from steam-shovel pits. ^c Includes California, Idaho, and Nevada. ^d Included in Alaska.

TABLE 29.—*Production, number of men employed, and number of men killed in and about the coal mines in the United States, etc.—(Continued.)*
 [The number in parentheses after each State refers to a like State table bearing the same number in Bulletin 115.]

State and year.	Production (short tons). ^a	Value per ton at mine. ^a	Number employed. ^a			Number killed.			Production per death (short tons).	Average tonnage per man. ^a		Percentage coal mined by— ^a						Number and kind of machines. ^a						Number of mines. ^a			
			Total.	Per 1,000 em- ployed.	Per 1,000,000 tons mined.	Days worked. ^a	Per year.	Per day.		Hand.	Machine.	Shot off solid.	Not reported. ^b	Pick.	Chain breast.	Long wall.	Short wall.	Radial ax or post.	Total.								
Georgia (93) and North Carolina (115):																											
1914.....	166,498	1.44	355	79,499	1	2.82	5.01	166,498	207	469	2.27																
1915.....	134,490	1.72	368	75,610	0			187	365	1.85	4.2																
1916.....	173,554	1.79	411	75,533	1	2.43	5.70	173,554	280	422	1.51																
1917.....	119,028	2.53	281	84,090	1	3.56	8.40	119,028	269	423	1.57																
1918.....	68,136	3.69	240	85,965	2	8.33	23.35	94,068	212		2.6																
Illinois (95):																											
1914.....	57,580	1.97	112	79,499	193	2.43	3.35	298,390	173	724	4.18																
1915.....	58,829	576	1.10	75,610	136	1.80	2.31	432,570	179	778	4.35																
1916.....	66,195	330	1.25	75,533	128	1.69	1.93	517,151	198	876	4.42																
1917.....	86,199	387	1.88	84,090	233	2.77	2.70	369,954	243	1,025	4.22																
1918.....	89,291	1.05	2.32	85,965	238	2.77	2.67	375,173	238	1,039	4.37																
Indiana (97):																											
1914.....	16,641	1.32	1.10	23,175	44	1.90	2.64	378,208	168	718	4.27																
1915.....	17,006	1.52	1.10	22,717	46	2.02	2.70	369,689	179	747	4.17																
1916.....	20,063	528	1.27	23,965	51	2.13	2.54	393,991	187	838	4.48																
1917.....	26,589	329	1.99	26,528	70	2.86	2.86	349,202	221	1,000	4.52																
1918.....	30,678	634	2.29	30,376	100	3.29	8.26	305,786	227	1,010	4.45																
Iowa (99):																											
1914.....	7,451	0.22	1.79	16,067	37	2.30	4.97	201,379	204	464	2.27																
1915.....	7,614	1.13	1.78	15,549	34	2.19	4.47	223,945	220	400	2.23																
1916.....	7,280	800	1.80	14,443	31	2.15	4.27	234,319	202	503	2.49																
1917.....	8,465	820	2.93	14,263	36	2.62	4.02	249,051	251	628	2.50																
1918.....	8,192	195	3.02	13,328	31	2.33	3.78	264,264	245	615	2.51																
Kansas (101):																											
1914.....	6,800	988	1.64	12,448	33	2.65	4.81	207,909	192	551	2.87																
1915.....	6,824	474	1.70	13,260	24	1.81	3.52	284,353	184	515	2.80																
1916.....	6,881	455	1.78	12,132	54	4.45	7.85	127,434	204	567	2.78																
1917.....	7,184	975	2.31	10,680	30	2.81	4.18	239,499	216	673	3.13																
1918.....	7,501	917	2.91	10,665	32	3.00	4.23	236,311	234	709	3.03																
Kentucky (103):																											
1914.....	20,382	763	1.02	28,764	61	2.12	2.99	334,144	187	709	3.79																
1915.....	21,361	674	1.01	27,960	64	2.29	3.00	333,776	195	704	4.11																

1916.	25,303,997	1.19	31,222	75	4.07	2.95	398,587	208	813	3.91	6.0	84.4	9.0	.6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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^b Since 1915 includes coal mined from steam-shovel pits.

Data furnished by U. S. Geological Survey.

Utah (132):	3,103,036	1.59	4,112	22	5.35	7.09	141,047	210	755	63.6	30.4	5.9	1	9	59	68	24
1914.....	3,108,715	1.58	3,564	11	3.09	3.54	282,610	208	872	4.19	49.6	2.9	2	.....	.....	67	.....
1915.....	3,567,428	1.62	3,129	23	7.35	6.45	155,106	228	1,140	50.0	41.7	57.5	8	.....	.....	78	.....
1916.....	4,125,200	2.07	3,485	22	6.31	5.33	187,510	219	1,184	5.41	.....	.....	.....	.....	.....	105	.....
1917.....	5,136,825	2.71	4,160	19	4.57	3.70	270,360	258	1,295	4.79	36.7	53.9	2	.....	.....	141	.....
Virginia (134):																	
1914.....	7,959,595	1.01	9,183	27	2.04	3.39	240,798	235	867	3.69	18.0	51.4	30.5	4	75	182	63
1915.....	8,122,586	.98	8,959	48	3.86	5.91	169,221	235	907	2.9	63.17	33.91	.02	.....	.....	186	.....
1916.....	9,707,474	1.06	9,777	53	5.42	5.46	183,160	272	993	3.65	4.4	61.9	33.7	.....	.....	194	.....
1917.....	10,087,091	2.00	11,168	63	5.44	6.25	160,113	273	993	3.31	.....	.....	.....	.....	.....	226	.....
1918.....	10,280,808	2.51	11,004	43	3.91	4.13	239,298	277	935	3.38	14.9	62.2	19.7	3.2	.....	231	.....
Washington (136):																	
1914.....	3,064,820	2.20	5,805	17	2.93	5.55	180,284	191	598	2.76	41.8	10.7	47.1	46	.....	72	58
1915.....	2,429,065	2.17	4,850	46	9.28	18.53	153,980	169	503	2.96	42.7	12.8	34.5	.....	1	73	.....
1916.....	3,038,588	2.27	4,797	21	4.38	6.91	144,665	217	653	2.92	58.2	9.1	32.7	.....	.....	55	.....
1917.....	4,009,902	2.68	5,312	30	5.65	7.48	133,663	271	755	2.79	.....	.....	.....	.....	.....	32	.....
1918.....	4,082,212	3.46	5,109	33	6.46	8.08	123,703	275	799	2.91	57.8	6.1	36.1	.....	.....	48	.....
West Virginia (138):																	
1914.....	71,707,626	.99	78,983	556	7.04	7.75	128,971	201	908	4.52	40.4	58.9	.5	517	1,407	2,607	822
1915.....	77,184,069	.97	75,882	494	6.71	6.40	156,243	208	1,017	4.89	39.3	60.0	.6	.....	.....	2,479	.....
1916.....	86,460,127	1.18	78,067	372	4.77	4.30	232,420	237	1,108	4.68	36.5	62.9	.5	.....	.....	2,702	.....
1917.....	86,441,667	2.32	88,422	384	4.34	4.44	225,109	225	978	4.35	.....	.....	.....	.....	.....	3,454	.....
1918.....	89,935,839	2.56	89,530	437	4.88	4.86	205,803	238	1,005	4.22	29.0	67.5	2.8	.....	.....	3,281	.....
Wyoming (140):																	
1914.....	6,475,293	1.55	8,117	51	6.28	7.88	126,967	192	798	4.16	23.7	42.2	34.0	56	78	198	56
1915.....	6,554,028	1.46	7,244	26	3.59	3.97	252,078	201	905	4.50	21.9	44.6	33.4	.....	.....	179	.....
1916.....	7,910,647	1.55	7,255	30	4.14	3.79	263,688	248	1,060	4.40	22.8	44.0	33.1	.....	.....	192	.....
1917.....	8,575,619	1.83	7,358	37	5.03	4.31	231,773	246	1,165	4.74	.....	.....	.....	.....	.....	161	.....
1918.....	9,438,688	2.39	7,554	41	5.43	4.34	230,212	268	1,249	4.66	2.16	47.3	29.7	.....	.....	163	.....
Total (bituminous):																	
1914.....	422,703,970	1.17	553,506	1,859	3.19	4.40	227,382	195	724	3.71	29.7	51.7	15.3	.....	.....	16,507	.....
1915.....	442,624,426	1.13	557,436	1,683	3.02	3.90	262,967	203	794	3.91	28.0	55.0	15.9	.....	.....	15,692	.....
1916.....	502,510,682	1.32	591,102	1,671	3.88	3.33	300,730	230	896	3.90	26.8	56.4	15.5	.....	.....	16,197	.....
1917.....	551,790,563	2.26	603,143	2,114	3.50	3.83	291,017	243	915	3.77	23.6	55.5	17.3	.....	.....	17,235	.....
1918.....	579,356,820	2.38	615,305	2,029	3.30	3.50	285,552	249	942	3.75	23.8	55.9	17.5	.....	.....	18,463	.....
Pennsylvania, anthracite (124):																	
1914.....	90,821,507	2.07	179,679	595	3.31	6.55	152,641	245	505	2.66	.....	.....	.....	.....	.....	271	.....
1915.....	88,995,061	2.07	176,552	586	3.32	6.58	151,849	230	504	2.17	.....	.....	.....	.....	.....	.....	.....
1916.....	87,578,493	2.20	159,869	555	3.47	6.34	157,799	253	548	2.19	.....	.....	.....	.....	.....	.....	.....
1917.....	90,611,811	2.54	154,174	582	3.77	5.84	171,154	285	646	2.27	.....	.....	.....	.....	.....	.....	.....
1918.....	96,826,084	3.40	147,121	551	3.75	5.53	179,358	293	672	2.29	.....	.....	.....	.....	.....	.....	.....
United States (2):																	
1914.....	513,525,477	1.33	763,185	2,454	3.22	4.78	200,261	207	673	3.25	29.7	51.7	15.3	3.3	5,878	618	128
1915.....	531,619,487	1.29	734,091	2,269	3.09	4.27	234,297	209	724	3.46	28.0	55.0	15.9	1.1	.....	.....	.....
1916.....	590,098,175	1.47	720,971	2,226	3.09	3.77	265,094	235	818	3.48	26.8	56.4	15.5	1.3	.....	.....	.....
1917.....	651,402,374	2.35	757,317	2,696	3.56	4.14	241,618	251	860	3.43	.....	.....	.....	.....	.....	.....	.....
1918.....	678,211,904	2.70	762,426	2,580	3.38	3.80	262,873	258	890	3.43	.....	.....	.....	.....	.....	.....	.....

b Since 1915 includes coal mined from steam-shovel pits.

c Data furnished by U. S. Geological Survey.

[illegible]

TABLE 30.—United States: Coal-mine fatalities during the years 1914 to 1919, inclusive, by causes and States—Continued.

[The number in parentheses after each State refers to a like State table bearing the same number in Bulletin 115.]

State.	Killed underground.												Killed in shaft.						Killed on the surface.						Total by States.	
	Killed underground.												Killed in shaft.						Killed on the surface.							
	Falls of roof (coal, rock, etc.).	Falls of face or pillar coal.	Mine cars and loco-motives.	Gas explosions and burning gas.	Coal-dust explosions (including gas and dust combined).	Explosives.	Suffocation from mine gases.	Electricity (shock or burns).	Animals.	Mining machines.	Mine fires (burned, suffocated, etc.).	Other causes.	Total.	Falling down shafts or slopes.	Objects falling down shafts or slopes.	Cage, skip, or bucket.	Other causes.	Total.	Mine cars and mine locomotives.	Electricity (shock or burns).	Machinery.	Boiler explosions or bursting steam pipes.	Railway cars and locomotives.	Other causes.		Total.
Maryland (106):	1914.....	15	1	1			2						17									1				1
	1915.....	5		1				1					9										1			10
	1916.....	11	2			16	2						31													32
	1917.....	15		4									19		1						1					22
	1918.....	8	2	5			2						17													17
Michigan (108):	1919.....	3		1			1						5													5
	1914.....	1							1				2													1
	1915.....	2						1		2			5													7
	1916.....	1					1						2		1								1			2
	1917.....						1						1													2
Missouri (110):	1918.....	6		2			1						9		1						1					12
	1919.....	2	1										3													3
	1914.....	12		2	2								14				5									19
	1915.....	4					6	1	3				16		1											17
	1916.....	6											6													6
Montana (112):	1917.....	9					1		1				11													11
	1918.....	8		1	1								11		1											13
	1919.....	5	1		1		1	1					9													10
	1914.....	7											7													8
	1915.....	9	2	2									11		1											13
1916.....	8	2	6									16													16	
1917.....	7	2	9	1		1						20		1						1			1		23	
1918.....	7	4	2									14								2						17
1919.....	2		3	1								8		1												11

NUMBER OF 8, 9, AND 10 HOUR EMPLOYEES IN COAL MINES, 1914 TO 1918.

Table 31, showing the number of 8, 9, and 10 hour employees, by States and years, is published as supplemental to similar data given in Bulletin 115, wherein the number of 8, 9, and 10 hour employees is given for the coal-mining industry from 1903 to 1913. The figures published herewith supplement those and bring the data down to the close of 1918, and were used as a basis upon which Tables 26, 27, and 28 were calculated and in which is shown the approximate number of 2,000-hour workers, 1914 to 1918.

STATISTICS OF STRIKES AND LOCKOUTS.

Table 31, showing data relating to strikes and lockouts at coal mines, was compiled from the annual volumes of Mineral Resources (U. S. Geological Survey) from 1899 to 1913 and published in Bureau of Mines Bulletin 115. Table 32 in this report extends the tabulation by States to the close of 1917. The page references after each State refer to a like State table (not numbered) in Bulletin 115.

COMPARISON OF FATALITY RATES IN THE MINERAL INDUSTRY.

Table 33 shows the number of men employed, average days worked, number killed, and the fatality rate per 1,000 men employed, and also fatality rate per 1,000 300-day workers. This data is given for comparative purposes, showing the relative fatality hazard at coal mines, metal mines, quarries, metallurgical plants, and coke ovens.

TABLE 31.—*Number of hours to the working day, in and about the coal mines in the United States, by States, for the years 1914 to 1918, inclusive.*

[Compiled from Mineral Resources, U. S. Geological Survey.]

[The page reference in parentheses after each State refers to a like State table in Bulletin 115, extending back to 1903.]

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
Alabama (p. 142):								
1914.....	14	646	24	3,546	150	18,115	1,735	24,042
1915.....	13	369	44	4,402	133	17,109	711	22,591
1916.....	9	306	40	2,724	132	20,376	1,902	25,308
1917.....	38	3,586	27	1,900	143	20,766	2,134	28,386
1918.....	235	24,129	3	72	8	872	1,148	26,221
Alaska:								
1914.....							43	a 43
1915.....							36	a 36
1916.....								83
1917 ^b								
1918.....								
Arkansas (p. 148):								
1914.....	53	4,314					25	4,339
1915.....	58	3,589					162	3,751
1916.....	60	3,628					144	3,772
1917.....	68	3,636	1	5	1	3	354	3,998
1918.....	74	3,416	1	8	1	13	541	3,978

^a Includes Idaho and Nevada.

^b Included in California and Idaho.

TABLE 31.—Number of hours to the working day, in and about the coal mines in the United States, by States, for the years 1914 to 1918, inclusive—Continued.

[The page reference in parentheses after each State refers to a like State table in Bulletin 115, extending back to 1903.]

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
California, Idaho, and Nevada:								
1914.....								(a)
1915.....								(a)
1916.....								18
1917.....							17	17
1918.....							15	15
Colorado (p. 160):								
1914.....	137	9,496	1	198	1	55	349	10,098
1915.....	153	12,259	1	2			111	12,372
1916.....	159	12,542			1	2	560	13,104
1917.....	130	12,238					1,993	14,231
1918.....	169	13,741	1	99	1	2	641	14,483
Georgia and North Carolina:								
1914.....							355	355
1915.....							368	368
1916.....								411
1917.....							281	281
1918.....							240	240
Illinois (p. 173):								
1914.....	455	78,672	9	99			728	79,499
1915.....	416	74,619	11	32			959	75,610
1916.....	437	74,702	8	56	1	3	777	75,538
1917.....	402	82,435	4	50			1,605	84,090
1918.....	454	85,320	3	33			612	85,965
Indiana (p. 182):								
1914.....	193	21,172	3	14	1	85	1,904	23,175
1915.....	193	22,364	4	12	7	69	332	22,777
1916.....	184	22,932	2	39	11	106	888	23,965
1917.....	181	24,294	2	42			2,192	26,528
1918.....	255	28,612	1	15			1,749	30,376
Iowa (p. 191):								
1914.....	175	15,514	2	8	1	4	531	16,057
1915.....	167	15,308	3	24			217	15,549
1916.....	160	13,574	3	22	1	16	831	14,443
1917.....	130	13,328	1	11			927	14,266
1918.....	125	12,242	1	12			1,074	13,328
Kansas (p. 199):								
1914.....	121	12,240					208	12,448
1915.....	134	12,870					390	13,260
1916.....	131	11,522					610	12,132
1917.....	120	10,144					536	10,680
1918.....	141	9,672					993	10,665
Kentucky (p. 208):								
1914.....	63	5,438	64	5,856	206	17,120	350	23,764
1915.....	58	5,249	75	7,325	188	14,793	593	27,960
1916.....	62	5,486	87	6,736	183	16,355	2,655	31,222
1917.....	217	16,738	84	5,488	69	3,833	8,867	34,926
1918.....	376	26,601	93	5,271	55	4,363	3,107	39,342
Maryland (p. 216):								
1914.....	5	55	1	17	51	5,261	70	5,403
1915.....	5	142	2	8	48	5,254	260	5,664
1916.....	1	3	10	205	58	5,390	35	5,633
1917.....	61	4,766	1	25	5	359	769	5,919
1918.....	85	5,334					234	5,568
Michigan (p. 224):								
1914.....	15	2,070					730	2,800
1915.....	17	2,569						2,569
1916.....	16	2,535						2,535
1917.....	19	2,375					31	2,406
1918.....	21	2,526					32	2,558
Missouri (p. 231):								
1914.....	165	9,366	2	23	2	33	127	9,549
1915.....	161	8,906	2	53	2	38	176	9,173
1916.....	158	9,340	1	6	4	92	216	9,654
1917.....	130	9,141	1	10	1	25	492	9,668
1918.....	149	8,685	5	99	2	31	775	9,590
Montana (p. 238):								
1914.....	49	3,193					157	3,350
1915.....	36	3,108					50	3,158
1916.....	41	3,776					11	3,787
1917.....	34	4,105					44	4,149
1918.....	44	4,470			2	8	81	4,559

TABLE 31.—*Number of hours to the working-day, in and about the coal mines in the United States, by States, for the years 1914 to 1918, inclusive—Continued.*

[The page reference in parentheses after each State refers to a like State table in Bulletin 115, extending back to 1903.]

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
New Mexico (p. 247):								
1914.	27	3,794	3	363	2	9	12	4,178
1915.	35	4,042	2	146	1	8	9	4,205
1916.	24	2,690	2	48	1	2	1,582	4,522
1917.	26	2,617					1,509	4,126
1918.	32	4,023	1	34			38	4,095
North Dakota (p. 254):								
1914.	14	51	10	91	20	403	13	558
1915.	19	76	7	27	17	471	16	590
1916.	17	87	5	41	17	554	32	714
1917.	10	109	2	30	15	320	362	821
1918.	16	464	1	15	9	112	207	828
Ohio (p. 262):								
1914.	531	43,718	11	189	3	19	1,475	45,401
1915.	500	38,410	19	287	3	20	1,336	40,053
1916.	521	40,052	20	327	4	30	985	41,394
1917.	489	43,423	7	82	9	481	1,523	45,509
1918.	635	46,184	9	242	15	645	1,370	48,450
Oklahoma (p. 272):								
1914.	82	7,806			2	74	198	8,078
1915.	88	7,833			2	49	575	8,457
1916.	95	7,521			8	81	198	7,800
1917.	98	7,890			2	56	549	8,495
1918.	109	7,777	2	109	1	10	555	8,451
Oregon:								
1914.	4	169					21	190
1915.	3	92					59	151
1916.	4	59					47	106
1917.	5	70					34	104
1918.								
Pennsylvania, bituminous (p. 299):								
1914.	819	103,291	291	32,293	263	44,643	3,974	184,201
1915.	779	90,969	278	40,159	275	40,046	2,789	174,593
1916.	828	84,794	338	38,436	299	57,468	7,614	166,212
1917.	1,293	124,824	230	27,293	79	6,135	15,716	173,964
1918.	1,698	161,586	146	7,439	52	4,198	11,083	174,806
South Dakota:								
1914.							47	47
1915.							35	35
1916.								38
1917.							34	34
1918.							21	21
Tennessee (p. 307):								
1914.	7	280	77	6,612	33	3,166	58	10,116
1915.	4	229	61	5,412	28	2,694	613	8,948
1916.	2	51	60	5,110	24	3,196	854	9,211
1917.	51	2,630	59	5,748	8	1,539	504	10,421
1918.	100	8,380	5	422	2	849	1,043	10,634
Texas (p. 313):								
1914.	25	2,707	2	160	17	1,229	539	4,635
1915.	19	2,935	8	301	16	1,458	393	5,087
1916.	22	2,566	13	762	12	1,153		4,481
1917.	13	2,213	16	930	12	946	286	4,375
1918.	16	2,074	15	855	6	577	430	3,936
Utah (p. 319):								
1914.	22	4,112						4,112
1915.	21	3,566					8	3,564
1916.	20	3,051	1	3			75	3,129
1917.	20	3,417	1	5			62	3,485
1918.	26	4,111	1	5			44	4,160
Virginia (p. 326):								
1914.	3	109	11	1,276	49	7,798		9,183
1915.			8	200	56	8,759		8,959
1916.	3	47	8	107	56	9,536	87	9,777
1917.	27	1,484	17	1,141	39	4,160	4,383	11,168
1918.	84	8,916	16	1,034	8	514	540	11,004
Washington (p. 334):								
1914.	53	5,751			1	34	20	5,805
1915.	52	4,809					41	4,850
1916.	44	4,793					4	4,797
1917.	47	5,085					227	5,312
1918.	51	5,070					39	5,109

TABLE 31.—*Number of hours to the working day, in and about the coal mines in the United States, by States, for the years 1914 to 1918, inclusive—Continued.*

[The page reference in parentheses after each State refers to a like State table in Bulletin 115, extending back to 1903.]

Year.	8-hour day.		9-hour day.		10-hour day.		Men employed other than 8, 9, or 10 hours per day.	Total number of men employed.
	Number of mines.	Men employed.	Number of mines.	Men employed.	Number of mines.	Men employed.		
West Virginia (p. 343):								
1914.....	35	3,144	394	36,612	361	37,826	1,381	78,663
1915.....	39	3,741	389	34,446	371	35,896	1,799	75,882
1916.....	35	2,994	426	38,997	371	34,923	1,153	78,067
1917.....	601	41,199	244	25,552	99	7,126	14,545	88,422
1918.....	915	58,782	263	23,540	54	3,385	3,823	89,539
Wyoming (p. 350):								
1914.....	53	7,706	.....	.....	1	2	499	8,117
1915.....	48	7,234	1	2	1	4	4	7,244
1916.....	48	6,882	.....	.....	.....	.....	373	7,255
1917.....	52	7,349	.....	.....	1	9	.....	7,358
1918.....	51	7,194	.....	.....	.....	.....	360	7,554
Total bituminous:								
1914.....	3,120	344,814	905	87,357	1,164	135,876	15,459	583,506
1915.....	3,018	325,308	910	92,838	1,148	127,268	12,042	557,456
1916.....	3,081	316,133	1,021	93,019	1,173	129,283	22,067	561,102
1917.....	4,262	429,095	697	68,313	483	45,758	59,976	605,143
1918.....	5,871	529,339	567	39,304	216	15,603	31,053	615,305
Pennsylvania, anthracite (p. 288):^a								
1914.....	.....	.....	.....	.....	.....	.....	179,679	174,679
1915.....	.....	.....	.....	.....	.....	.....	176,552	176,552
1916.....	.....	159,869	.....	.....	.....	.....	.....	159,869
1917.....	.....	154,174	.....	.....	.....	.....	.....	154,174
1918.....	.....	147,121	.....	.....	.....	.....	.....	147,121
Total, United States:								
1914.....	.....	344,814	.....	87,357	.....	135,876	195,138	763,185
1915.....	.....	325,308	.....	92,838	.....	127,268	188,594	734,008
1916.....	.....	476,002	.....	93,619	.....	129,283	22,067	720,471
1917.....	.....	583,270	.....	68,313	.....	45,758	59,976	757,317
1918.....	.....	676,460	.....	39,304	.....	15,603	31,053	762,425

^a Employees not segregated. Prior to May, 1916, operations were not conducted on basis of a 9-hour day. Since then the 8-hour day is standard. Number of mines not given.**TABLE 32.**—*Statistics of strikes and lockouts at coal mines in the United States, by States, for the years 1914 to 1918.^a*

[The page references in parentheses after each State refer to a like State table in Bulletin 115, extending back to 1899.]

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
Alabama (p. 143):				Colorado (p. 161):			
1914.....	320	3,940	12	1914.....	1,418	1,090,025	247
1915.....	175	1,290	7	1915.....	90	13,500	152
1916.....	300	920	3	1916.....	38	82	4
1917.....	1,835	10,220	6	1917.....	1,664	7,292	8
1918.....	.....	.....	.....	1918.....	.....	.....	.....
Alaska:				Georgia and North Carolina:			
1914.....	.....	.....	.....	1914.....	.....	.....	.....
1915.....	.....	.....	.....	1915.....	.....	.....	.....
1916.....	.....	.....	.....	1916.....	.....	.....	.....
1917.....	.....	.....	.....	1917.....	.....	.....	.....
1918.....	.....	.....	.....	1918.....	.....	.....	.....
Arkansas (p. 149):				Illinois (p. 173):			
1914.....	1,415	159,854	113	1914.....	23,506	970,466	41
1915.....	925	20,304	22	1915.....	5,251	276,458	53
1916.....	1,009	30,847	31	1916.....	5,043	55,416	11
1917.....	2,417	27,315	11	1917.....	38,781	464,511	12
1918.....	.....	.....	.....	1918.....	.....	.....	.....
California, Idaho, and Nevada:				Indiana (p. 183):			
1914.....	.....	.....	.....	1914.....	8,052	392,855	35
1915.....	.....	.....	.....	1915.....	1,472	21,361	15
1916.....	.....	.....	.....	1916.....	8,154	154,974	19
1917.....	.....	.....	.....	1917.....	11,914	47,695	6
1918.....	.....	.....	.....	1918.....	.....	.....	.....

^a Data compiled from reports of United States Geological Survey.

TABLE 32.—Statistics of strikes and lockouts at coal mines in the United States—Contd.

[The page references in parentheses after each State refer to a like State table in Bulletin 115, extending back to 1899.]

Year.	Number of men affected.	Total days lost.	Average number of days lost per man.	Year.	Number of men affected.	Total days lost.	Average number of days lost per man.
Iowa (p. 191):				Pennsylvania, bituminous (p. 299):			
1914.....	2,642	76,791	29	1914.....	36,613	1,052,005	29
1915.....	1,067	5,229	5	1915.....	5,583	78,446	14
1916.....	2,244	32,587	15	1916.....	36,276	1,200,479	33
1917.....	3,275	18,407	6	1917.....	23,655	544,322	23
1918.....				1918.....			
Kansas (p. 199):				South Dakota:			
1914.....	2,673	45,257	17	1914.....			
1915.....	1,716	17,425	10	1915.....			
1916.....	6,306	152,838	24	1916.....			
1917.....	7,312	128,514	18	1917.....			
1918.....				1918.....			
Kentucky (p. 209):				Tennessee (p. 307):			
1914.....	2,250	82,919	37	1914.....			
1915.....	1,045	16,455	16	1915.....			
1916.....	4,830	269,859	56	1916.....	350	3,784	11
1917.....	9,348	425,725	46	1917.....	4,448	192,730	43
1918.....				1918.....			
Maryland (p. 217):				Texas:			
1914.....	91	1,547	17	1914.....	221	693	3
1915.....				1915.....	230	760	3
1916.....	181	6,546	36	1916.....	2,218	62,905	28
1917.....	1,523	24,605	16	1917.....	75	260	3
1918.....				1918.....			
Michigan (p. 225):				Utah (p. 319):			
1914.....				1914.....	150	1,800	12
1915.....				1915.....			
1916.....	1,416	18,189	13	1916.....	181	543	3
1917.....	163	1,964	12	1917.....	212	848	4
1918.....				1918.....			
Missouri (p. 231):				Virginia:			
1914.....	1,162	58,536	49	1914.....			
1915.....	939	4,597	5	1915.....	7	7	1
1916.....	2,331	14,837	6	1916.....			
1917.....	2,175	31,767	15	1917.....	232	2,283	10
1918.....				1918.....			
Montana (p. 239):				Washington (p. 335):			
1914.....	171	1,271	7	1914.....	459	25,410	55
1915.....	183	1,084	6	1915.....			
1916.....	396	1,580	4	1916.....	1,203	13,304	11
1917.....	1,063	23,680	22	1917.....	192	840	4
1918.....				1918.....			
New Mexico (p. 247):				West Virginia (p. 343):			
1914.....				1914.....	9,330	466,768	50
1915.....				1915.....	1,902	66,698	25
1916.....				1916.....	4,540	86,352	19
1917.....	85	775	9	1917.....	6,166	111,479	18
1918.....				1918.....			
North Dakota (p. 255):				Wyoming (p. 351):			
1914.....				1914.....	248	2,727	11
1915.....				1915.....	219	2,628	12
1916.....	26	78	3	1916.....	276	308	1
1917.....	82	811	10	1917.....			
1918.....				1918.....			
Ohio (p. 263):				Total bituminous:			
1914.....	40,577	6,452,762	159	1914.....	135,605	10,833,924	80
1915.....	15,048	1,722,013	114	1915.....	36,865	2,252,740	61
1916.....	7,594	156,689	21	1916.....	91,152	2,389,519	26
1917.....	7,710	56,875	7	1917.....	126,020	2,187,244	17
1918.....				1918.....			
Oklahoma (p. 273):				Pennsylvania anthracite (p. 289):			
1914.....	1,286	39,500	31	1914.....	26,115	179,743	7
1915.....	1,013	4,485	4	1915.....	30,325	214,691	7
1916.....	6,240	126,452	20	1916.....	79,481	955,067	12
1917.....	1,668	37,301	22	1917.....	34,220	161,155	5
1918.....				1918.....			
Oregon (p. 278):				Total, United States:			
1914.....	21	798	38	1914.....	161,720	11,013,667	68
1915.....				1915.....	67,190	2,467,431	37
1916.....				1916.....	170,633	3,344,586	20
1917.....	25	25	1	1917.....	160,240	2,348,399	15
1918.....				1918.....			

TABLE 33.—Comparison of fatality rates in the mineral industry in the United States.

	Average days active.	Men employed.	Killed.	Killed per 1,000 employed.	Killed per 1,000 300-day workers.
	(1)	(2)	(3)	(4) ^a	(5) ^a
Coal mines:					
1907.....	231	680,492	3,242	4.76	6.19
1908.....	195	690,438	2,445	3.54	5.45
1909.....		666,552	2,642	3.96	
1910.....	220	725,030	2,821	3.89	5.31
1911.....	220	728,348	2,656	3.65	4.97
1912.....	225	722,662	2,419	3.35	4.46
1913.....	238	747,644	2,785	3.73	4.70
1914.....	207	763,185	2,454	3.22	4.66
1915.....	209	734,008	2,269	3.09	4.44
1916.....	235	720,971	2,226	3.09	3.94
1917.....	251	757,317	2,696	3.56	4.25
1918.....	258	762,426	2,580	3.38	3.94
1919.....			2,307		
Metal mines:					
1911.....	282	165,979	695	4.19	4.45
1912.....	287	169,199	661	3.91	4.09
1913.....	288	191,276	683	3.57	3.72
1914.....	271	158,115	559	3.54	3.92
1915.....	280	152,118	553	3.64	3.89
1916.....	282	204,685	697	3.41	3.62
1917.....	287	200,579	852	4.25	4.44
1918.....	297	182,606	646	3.54	3.57
Quarries:					
1911.....	228	110,954	188	1.69	2.23
1912.....	249	113,105	213	1.88	2.27
1913.....	246	106,278	183	1.72	2.10
1914.....	233	87,936	180	2.05	2.64
1915.....	246	100,740	148	1.47	1.80
1916.....	253	90,797	173	1.91	2.26
1917.....	261	82,290	131	1.59	1.83
1918.....	260	68,332	125	1.83	2.11
Metallurgical plants:					
Ore-dressing—					
1913.....	323	14,985	16	1.07	.99
1914.....	302	15,128	23	1.52	1.51
1915.....	309	18,564	30	1.62	1.57
1916.....	315	22,365	33	1.48	1.41
1917.....	303	24,111	47	1.95	1.93
1918.....	310	21,809	35	1.60	1.55
Smelting—					
1913.....	355	20,564	47	2.29	1.93
1914.....	348	27,879	33	1.19	1.02
1915.....	347	31,327	38	1.21	1.05
1916.....	338	43,829	36	.82	.73
1917.....	342	44,376	53	1.19	1.05
1918.....	342	39,899	42	1.05	.92
Coke ovens:					
Beehive and by-product—					
1913.....	288	24,345	46	1.89	1.97
1914.....	286	22,313	45	2.02	2.12
1915.....	303	31,060	38	1.22	1.21
1916.....	324	31,603	45	1.42	1.32
1917.....	329	32,417	76	2.34	2.14
1918.....	329	32,389	73	2.25	2.06
Beehive—					
1915.....	262	17,699	10	.57	.65
1916.....	300	18,570	24	1.29	1.29
1917.....	308	18,820	25	1.33	1.30
1918.....	300	16,442	19	1.16	1.16
By-product—					
1915.....	359	13,361	28	2.10	1.75
1916.....	357	13,033	21	1.61	1.35
1917.....	360	13,597	51	3.75	3.13
1918.....	358	15,947	54	3.39	2.84

^a Column 4 gives in the usual way the fatality rate based upon the actual number of employees, regardless of the length of time worked. Column 5 gives a fatality rate based on 1,000 300-day workers. This rate is comparable, one year with another, also one group with another, as the time element has been taken into consideration and all labor equated to a 300-day basis.

STEAM-RAILWAY AND COAL-MINE ACCIDENTS COMPARED.

Table 34 shows the actual fatality rates, 1909 to 1916, inclusive, for the underground employees of the coal mines of Pennsylvania and for trainmen, trackmen, and switchmen in the railway operations. It will be noted that in almost every case the fatalities among the trainmen, an occupation in which 250,000 to 300,000 men are employed, are higher than either the anthracite or bituminous coal mines. The bituminous mines occupy an intermediate place between the anthracite mines of Pennsylvania and the railway trainmen as regards the accident hazard.

TABLE 34.—*Coal-mine fatalities versus steam-railway fatalities, per 1,000 employees, 1909 to 1916.*

Year.	Underground fatalities, Pennsylvania coal mines.		Railway fatalities.		
	Anthracite.	Bituminous.	Trainmen.	Trackmen.	Switchmen, crossing tenders, and watchmen.
1909.....	3.97	3.12	4.87	1.39	2.03
1910.....	4.19	3.03	5.41	1.70	2.22
1911.....	4.88	3.23	5.49	1.40	2.65
1912.....	3.90	2.73	5.22	1.64	3.22
1913.....	4.33	3.59	5.05	1.54	3.27
1914.....	3.98	2.33	4.73	1.41	3.06
1915.....	4.01	2.61	3.53	1.39	2.23
1916.....	4.28	2.92	4.07	1.48	2.89

Table 35 shows a comparative statement of fatalities due to accidents on steam railways and accidents in the coal mines of Pennsylvania. The principal group occupations of each industry are given with the relative hazards of each, when based on the actual number of men employed. The Pennsylvania coal mines are taken as representative of the coal-mining industry as they include about one-half of the employees engaged in the production of coal in the United States, and, furthermore, the records by occupations in that State are more complete than for many of the other States. The occupations classified in the table are as follows: Miners, mine laborers, drivers, runners, and door boys, and all other underground employees. The surface employees in both the anthracite and bituminous mines are eliminated as are the office employees of the railway company. In this way it is possible to obtain comparative figures for the most hazardous occupations in each industry.

TABLE 35.—Comparative statement: Steam-railway accidents a in United States and coal-mine accidents b in Pennsylvania.

Industry and occupation.	1911				1912				1913				1914				1915				1916			
	Employed.	Killed.	Killed per 1,000 em- ployed.		Employed.	Killed.	Killed per 1,000 em- ployed.		Employed.	Killed.	Killed per 1,000 em- ployed.		Employed.	Killed.	Killed per 1,000 em- ployed.		Employed.	Killed.	Killed per 1,000 em- ployed.		Employed.	Killed.	Killed per 1,000 em- ployed.	
Steam railways:																								
Trammen.....	311,187	1,708	5.49		318,329	1,063	5.22		336,444	1,700	5.05		311,990	1,477	4.73		250,684	884	3.53		305,282	1,344	4.40	
Trackmen.....	407,494	570	1.40		401,603	660	1.64		421,608	651	1.54		382,428	540	1.41		259,096	359	1.39		319,580	474	1.48	
Switch and crossing tenders and watch- men.....	40,005	106	2.65		38,773	125	3.22		38,253	125	3.27		37,873	116	3.00		27,777	62	2.23		30,486	88	2.89	
All others.....	818,786	487	.59		862,653	472	.55		919,563	463	.50		874,006	390	.45		690,690	289	.41		786,192	404	.51	
Total, except office employees.....	1,577,472	2,871	1.82		1,621,358	2,920	1.80		1,715,868	2,039	1.71		1,600,297	2,553	1.57		1,234,247	1,594	1.29		1,451,540	2,210	1.52	
Pennsylvania anthracite mines:																								
Miners.....	45,324	306	6.75		44,696	262	5.80		44,346	286	6.45		45,897	296	6.45		46,422	281	6.05		44,380	274	6.17	
Miners' laborers.....	32,905	176	5.35		33,438	117	3.50		33,973	148	4.36		37,030	126	3.40		36,579	143	3.93		27,751	109	3.93	
Drivers, runners, door boys.....	14,077	60	4.26		13,928	50	3.59		14,074	40	2.84		13,931	36	2.60		13,284	50	3.76		13,472	40	2.97	
All others.....	38,731	73	2.16		38,745	69	1.83		36,274	83	2.29		37,915	76	2.04		35,211	53	1.51		30,480	74	2.43	
Total underground...	126,037	615	4.88		127,807	498	3.90		128,667	557	4.33		131,073	584	4.48		131,290	527	4.01		116,092	197	1.70	
Pennsylvania bituminous coal mines:																								
Miners.....	66,864	297	4.44		60,964	215	3.53		59,986	254	4.23		64,953	185	2.83		57,631	207	3.59		49,019	166	3.39	
Machine runners, load- ers, and scrapers.....	55,631	127	2.28		56,163	62	1.10		62,946	162	2.57		69,892	105	1.50		66,005	87	1.32		56,814	109	1.92	
Drivers, runners, door boys, and helpers.....	11,296	34	3.01		11,599	36	3.10		12,046	45	3.74		11,414	17	1.49		10,874	26	2.39		12,957	30	2.32	
All others.....	17,995	62	3.45		20,215	94	4.65		21,396	100	4.70		19,622	80	4.08		21,371	87	4.07		22,145	107	4.83	
Total underground...	151,786	590	3.93		148,941	407	2.73		156,274	561	3.59		165,881	387	2.33		155,881	407	2.61		140,935	412	2.92	

a Compiled from reports of the Interstate Commerce Commission, covering years ended June 30, 1911, to 1915, and year ended Dec. 31, 1916.

b Compiled from reports of the Department of Mines, Harrisburg, Pa.

COAL PRODUCTION AND FATALITIES BY MONTHS, 1913 TO 1919.

Table 36 shows the monthly production of anthracite and bituminous coal in the United States from 1913 to 1919, inclusive. It also shows the percentage of the total coal mined each month during the year, for which in the prewar period October, November, December, and January have the largest production, while the spring and summer months show slightly less. The figures, however, for 1917 and 1918 show a more equal distribution of monthly production. This no doubt is due to the abnormal conditions produced by the war, whereby large quantities of coal were essential for the operation of munition plants, railroad transportation of war material, and for bunker purposes for transport of soldiers and munitions.

In connection with the foregoing monthly production figures, Table 37 shows the number of fatalities by months for the corresponding period so that anyone interested in a study of mine fatalities on a monthly or a tonnage basis will have the necessary data.

COAL PRODUCTION IN FOREIGN COUNTRIES.

Table 38 shows the production of coal in the important foreign countries of the world for the years 1913 to 1918, inclusive. As indicated in 1913, the United States produced 38.5 per cent of the total output of the world's coal, while in 1918, based on the estimated production of some of the foreign countries, the United States produced 46.2 per cent of the entire world's production. The production in some of the more important foreign countries is apparently on the decline, while there has been a steady increase in this country's production.

TABLE 36. — *Monthly production of anthracite and of bituminous coal in the United States, 1913 to 1919.*^a

[Net tons.]

	1913		1914		1915		1916		1917		1918		1919	
	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.
Bituminous:														
January.....	42,276,000	8.8	40,188,000	9.5	37,100,000	8.4	46,506,000	9.3	47,967,000	8.7	42,227,000	7.3	41,457,000	9.1
February.....	37,057,000	7.7	35,472,000	8.4	29,321,000	6.6	48,187,000	9.0	41,353,000	7.5	43,771,000	7.6	31,566,000	6.9
March.....	37,536,000	7.8	43,435,000	10.8	31,801,000	7.2	43,826,000	8.7	47,869,000	8.7	43,113,000	8.3	33,719,000	7.0
April.....	34,161,000	7.2	23,609,000	6.8	23,968,000	6.8	33,628,000	6.7	41,834,000	7.6	46,041,000	8.0	32,164,000	7.0
May.....	37,205,000	7.8	30,338,000	7.4	30,338,000	7.0	38,804,000	7.5	47,086,000	8.5	50,443,000	8.7	37,547,000	8.2
June.....	37,405,000	7.8	31,412,000	8.1	33,957,000	7.7	37,742,000	7.5	46,824,000	8.5	51,138,000	8.8	37,054,000	8.1
July.....	38,858,000	8.1	34,305,000	8.1	35,575,000	8.0	38,113,000	7.6	46,292,000	8.4	54,971,000	9.5	42,698,000	9.4
August.....	41,590,000	8.7	37,751,000	8.9	38,161,000	8.6	42,696,000	8.5	47,372,000	8.6	55,114,000	9.5	42,883,000	9.4
September.....	41,424,000	8.7	39,019,000	9.2	40,964,000	9.3	42,098,000	8.4	45,108,000	8.2	51,183,000	8.8	47,402,000	10.3
October.....	46,164,000	9.7	37,685,000	8.9	44,198,000	10.0	44,807,000	8.9	48,337,000	8.7	52,300,000	9.0	56,243,000	12.3
November.....	43,233,000	9.0	37,392,000	7.9	44,737,000	10.1	44,927,000	8.9	47,690,000	8.6	43,895,000	7.6	18,688,000	4.1
December.....	41,519,000	8.7	35,892,000	8.5	45,814,000	10.3	44,098,000	8.8	44,037,000	8.0	40,184,000	6.9	36,612,000	8.0
Total for year.....	478,434,000	100.0	422,704,000	100.0	442,626,000	100.0	502,520,000	100.0	551,791,000	100.0	579,386,000	100.0	458,063,000	100.0
Anthracite:														
January.....	8,386,000	9.2	6,878,000	7.6	6,337,000	7.1	7,649,000	8.7	7,672,000	7.7	7,270,000	7.3	7,651,000	8.9
February.....	7,519,000	8.2	5,477,000	6.0	5,703,000	6.4	7,494,000	8.5	6,688,000	6.7	7,404,000	7.6	4,932,000	5.8
March.....	7,505,000	7.1	6,863,000	7.6	6,654,000	7.5	7,964,000	9.1	9,036,000	9.1	9,382,000	9.3	5,079,000	5.9
April.....	7,908,000	8.6	8,069,000	8.9	7,729,000	8.8	7,887,000	6.7	7,232,000	7.0	8,211,000	8.3	7,736,000	7.8
May.....	7,945,000	8.7	8,348,000	9.2	7,807,000	8.8	7,912,000	8.2	8,633,000	9.0	8,800,000	9.0	7,364,000	8.9
June.....	7,911,000	8.6	8,147,000	9.0	7,157,000	8.0	7,327,000	8.4	8,103,000	9.1	8,865,000	9.0	7,245,000	8.4
July.....	7,272,000	7.8	7,165,000	7.9	6,691,000	7.5	7,052,000	8.1	8,684,000	8.7	9,134,000	9.2	7,803,000	9.1
August.....	7,384,000	8.1	7,288,000	8.0	7,161,000	8.0	7,190,000	7.3	8,058,000	9.1	9,238,000	9.4	7,922,000	9.2
September.....	8,369,000	9.2	8,830,000	9.7	7,423,000	8.3	7,206,000	8.2	8,230,000	8.2	9,038,000	8.1	7,333,000	8.5
October.....	7,608,000	8.4	7,850,000	8.7	8,761,000	9.9	7,630,000	7.7	8,183,000	9.2	8,105,000	8.2	8,459,000	9.8
November.....	7,504,000	8.2	7,578,000	8.3	8,514,000	9.6	7,730,000	8.9	8,453,000	8.6	6,803,000	6.9	7,701,000	8.9
December.....	91,525,000	100.0	90,822,000	100.0	88,965,000	100.0	87,578,000	100.0	99,612,000	100.0	98,826,000	100.0	86,200,000	100.0
Total for year.....	569,960,219	.....	513,525,477	.....	581,619,487	.....	590,098,175	.....	651,402,374	.....	678,211,904	.....	544,263,000	.....
Grand total, bituminous and anthracite.....														

^a Monthly production estimated for bituminous coal on basis of rail shipments; for anthracite, on basis of monthly reports of Anthracite Bureau of Information. The above monthly production figures were compiled by the U. S. Geological Survey, and percentages calculated by the U. S. Bureau of Mines.

TABLE 37.—*Coal-mine fatalities by months and years, 1913 to 1919.*

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Bituminous:													
1913.....	168	150	150	229	144	139	137	176	132	426	168	148	2,167
1914.....	167	130	165	298	101	143	125	141	148	132	113	130	1,869
1915.....	113	133	235	114	99	104	165	129	135	133	181	142	1,683
1916.....	135	178	128	115	116	108	139	155	116	145	179	157	1,671
1917.....	170	130	182	200	136	188	189	217	140	142	173	187	2,114
1918.....	160	171	148	109	168	183	214	194	198	172	125	127	2,029
1919.....	138	128	138	139	140	151	153	180	138	194	58	115	1,672
Total.....	1,051	1,020	1,146	1,324	904	1,016	1,122	1,192	1,007	1,404	997	1,012	13,195
Anthracite:													
1913.....	55	58	52	56	62	53	47	67	41	50	34	43	618
1914.....	36	42	48	56	63	47	43	39	61	61	46	53	595
1915.....	53	46	47	55	54	45	32	50	43	56	59	40	586
1916.....	64	47	70	39	28	39	40	53	45	52	32	46	555
1917.....	57	38	48	49	45	44	58	52	41	55	57	38	582
1918.....	55	51	48	46	43	47	62	55	32	43	32	37	531
1919.....	44	31	33	48	44	144	68	43	41	49	36	54	635
Total.....	304	313	346	349	339	419	350	359	304	365	296	317	4,122

TABLE 38.—*Production of coal in the important countries of the world, 1913 to 1918.*

[Compiled by United States Geological Survey.]

[In net tons.]

	1913	1914	1915	1916	1917	1918
United States.....	569,960,219	513,525,477	531,619,457	590,098,175	651,402,374	678,211,901
Great Britain.....	321,922,130	297,698,617	283,560,980	287,140,410	278,319,140	253,040,328
Germany.....	305,714,654	270,594,952	259,130,782	272,099,000	c 281,499,000	c 273,350,000
Austria-Hungary.....	40,575,201	373,396,400	b 52,670,712	b 55,482,000	a 50,000,000	a 50,000,000
France.....	45,108,544	32,755,156	a 21,946,000	a 23,670,000	a 31,847,000	a 30,864,000
Russia.....	35,000,671	36,414,560	51,138,400	28,362,724	a 30,047,000	15,229,000
Belgium.....	25,106,869	18,424,000	15,691,000	18,388,000	a 16,446,000	a 30,600,000
Japan.....	23,983,282	24,374,000	22,539,000	25,238,000	a 28,000,000	a 30,600,000
China.....	13,432,200	a 10,199,200	a 19,800,000	a 22,000,000	.....	.....
India.....	18,163,856	18,439,975	18,673,984	13,389,372	19,405,550	14,379,213
Canada.....	15,115,089	13,637,529	13,267,023	14,401,678	14,046,759	9,290,000
New South Wales.....	11,063,865	11,644,476	10,582,889	9,102,420	6,619,102	10,160,000
Spain.....	4,731,647	4,877,000	5,155,000	6,160,380	.....	.....
Union of South Africa.....	9,857,361	9,401,674	9,275,083	11,208,402	11,628,870	11,437,082
New Zealand.....	2,115,834	2,548,664	2,473,659	2,527,991	2,316,629	.....
Holland.....	2,064,608	2,121,394	2,488,303	2,920,000	3,326,000	5,277,813
Chile.....	1,362,334	1,198,000	1,291,000	1,563,000	.....	.....
Queensland.....	1,162,497	1,180,825	1,147,186	1,016,654	1,174,290	1,101,176
Mexico.....	a 982,000	.....	.....	.....	.....	.....
Turkey.....	a 909,000	.....	.....	.....	.....	.....
Italy.....	772,802	859,516	1,045,256	1,439,538	a 2,050,000	.....
Victoria.....	688,524	691,644	588,104	468,270	a 566,067	.....
Indo-China.....	617,912	608,660	708,800	.....	.....	.....
Dutch East Indies.....	453,136	626,351	485,158	539,816	a 910,000	a 1,000,000
Sweden.....	401,199	404,146	457,184	457,952	.....	.....
West Australia.....	351,687	357,526	321,065	337,709	.....	.....
Serbia.....	a 335,000	.....	.....	.....	.....	.....
Bulgaria.....	a 325,000	.....	.....	.....	.....	.....
Peru.....	301,870	317,923	323,680	351,703	365,802	.....
Roumania.....	a 267,000	391,384	498,904	491,332	.....	.....
Rhodesia.....	237,728	68,130	96,000	62,244	.....	.....
Tasmania.....	61,648	.....	.....	.....	.....	.....
Other countries.....	a 2,550,000	.....	.....	.....	.....	.....
Approximate total for the world.....	1,478,000,000	1,332,000,000	1,312,000,000	1,401,000,000	1,473,000,000	1,468,000,000
Per cent of world total produced by United States.....	38.5	38.5	40.5	42.1	44.2	46.2

a Estimate, subject to revision.

b Hungarian production estimated at 10,000,000 tons.

c German lignite production estimated at 97,000,000 tons.

NOTE.—Because of the confusion introduced by the war into the official statistics of many countries, the above figures must be regarded as tentative and subject to revision. (U. S. Geol. Surv.)

APPROVED PERMISSIBLE LAMPS AND MINING EQUIPMENT.

As a result of the bureau's educational campaign for safety at mines and the reduction of mine accidents, coal mines are using explosives and equipment that have passed certain specified tests conducted by the bureau's engineers.

The following schedules cover the tests that lamps and mining equipment must pass in order to be approved for use in gaseous and dusty mines: Schedule 2A^a for electrical equipment, such as motors and coal cutting machines; Schedule 6A^b for portable electric lamps; Schedule 7^c for flame safety lamps; Schedule 11^d for electric flash lamps; and Schedule 13^e for testing rescue breathing apparatus.

The various schedules named above, stating the conditions and requirements^f under which these permissible devices are tested, may be obtained by application to the Director, Bureau of Mines, Washington, D. C.

APPROVED MINE-RESCUE BREATHING APPARATUS.

The Gibbs mine-rescue and breathing apparatus, manufactured by the Mine Safety Appliances Co., 909 Chamber of Commerce Building, Pittsburgh, Pa., and the Paul mine-rescue breathing apparatus, manufactured by the American Atmos Co., Wilkinsburg Station, Pittsburgh, Pa., were approved, January 15, 1920, as permissible for use in irrespirable and poisonous gases in accordance with Schedule 13. Approval numbers 1300 and 1301 were assigned to the Gibbs and Paul apparatus, respectively.

Approvals of each apparatus were made contingent upon certain modifications which had been incorporated in the apparatus as tested at the bureau.

APPROVAL No. 1300.—The Gibbs apparatus modifications are:

1. *Regenerator*.—Baffle plate is placed in regenerator so as to form a partial partition, as shown in drawing D 254 of December 4, 1919.

^a Procedure for establishing a list of permissible explosion-proof electric motors for mines; fees, character of tests, and conditions under which motors will be tested: Schedule 2A, Bureau of Mines, 1915, 11 pp.

^b Procedure for establishing a list of permissible portable electric mine lamps; fees, character of tests, and conditions under which lamps will be tested: Schedule 6A, Bureau of Mines, 1915, 13 pp.

^c Procedure for establishing a list of permissible miners' safety lamps; character of tests, conditions under which lamps will be tested, and fees: Schedule 7, Bureau of Mines, 1915, 10 pp.

^d Procedure for establishing a list of permissible flash lamps that are safe for use in explosive mixtures of methane and air; fees, character of test, and conditions under which lamps will be tested: Schedule 11, Bureau of Mines, 1916.

^e Procedure for establishing a list of permissible self-contained mine-rescue breathing apparatus. Schedule 13, Bureau of Mines, 1919.

^f All approved equipment must be identified by a plate bearing the seal of the Department of the Interior, Bureau of Mines, and the statement and number of the approval. Equipment that is not so identified is not considered as approved.

2. *Reducing valve*.—Lug is attached on valve arm steel to prevent knife edges from going over dead center, as shown in drawing B 541 of November 5, 1919.

3. *Reducing valve*.—A square head and square socket lock is made on screw connected to bellows, as per drawing D 541 of November 5, 1919.

4. *Reducing valve*.—A lock is placed on adjusting screw, as per drawing B 541 of November 5, 1919.

5. *Pressure gage closing valve* is made a needle-point closing valve, as shown on drawing B 541 of November 5, 1919.

APPROVAL NO. 1301.—The Paul apparatus modifications are:

1. *Closing valve lock*.—A chain fastened to the metal frame of the apparatus connects to eyelet on wheel of closing valve stem only when valve is open.

2. *Safety valve in saliva trap*.—A supplemental mica disk valve is placed in saliva trap in such manner that it is open at all times during exhalation and closes during inhalation. This is for the purpose of preventing drawing in of air from the outside atmosphere.

3. *Pressure gage*.—Dial of pressure gage is graduated in divisions of 25 atmospheres, with figures and markings that are clearly legible.

4. *Pressure gage valve*.—Pressure gage valve is placed in proximity to closing valve in such manner that it can be readily manipulated by wearer.

5. *Regenerator*.—Air courses through regenerating material are enlarged and metal partition in back of canister is eliminated.

6. *Breathing bag*.—Adjustment of closing of automatic valve in breathing bag is so made that undue resistance on account of excess pressure in bag upon exhalation is eliminated.

With both apparatus formal recommendation is made that by-pass valve and connection, as placed on the apparatus tested by the bureau, be made a part of all these apparatus manufactured in the future. It is believed that very shortly all Gibbs and Paul apparatus will have such a by-pass, and it will be the bureau's policy to equip all its apparatus with by-pass valve and connections as soon as time permits.

Both approvals cover only apparatus identical in construction and material with the full-size working models of each retained at Pittsburgh station for reference.

Steps are being taken by other manufacturers of breathing apparatus toward the testing of their apparatus by the bureau in accordance with Schedule 13.

**PERMISSIBLE LAMPS AND MINING EQUIPMENT APPROVED
PRIOR TO FEBRUARY 1, 1920.**

By L. C. ILSLEY.

EXPLOSION-PROOF COAL-CUTTING EQUIPMENT.

In accordance with Schedule 2A, the following coal-cutting equipment has the bureau's approval:

Approval No. 100, covering a 250-volt direct-current explosion-proof coal-cutting equipment manufactured by the Sullivan Machinery Co., Claremont, N. H.

Approval No. 100A, covering a 500-volt direct-current explosion-proof coal-cutting equipment manufactured by the Sullivan Machinery Co., Claremont, N. H.

Approval No. 101, covering a 210-volt direct-current explosion-proof coal-cutting equipment manufactured by the Goodman Manufacturing Co., Chicago, Ill.

Approval No. 101A, covering a 500-volt direct-current explosion-proof coal-cutting equipment manufactured by the Goodman Manufacturing Co., Chicago, Ill.

Approval No. 102, covering a 250-volt direct-current explosion-proof coal-cutting equipment manufactured by the Jeffrey Manufacturing Co., Columbus, Ohio.

Approval No. 102A, covering a 500-volt direct-current explosion-proof coal-cutting equipment manufactured by the Jeffrey Manufacturing Co., Columbus, Ohio.

Approval No. 103, covering a 250-volt direct-current explosion-proof coal-cutting equipment manufactured by the Jeffrey Manufacturing Co., Columbus, Ohio.

Approval No. 103A, covering a 500-volt direct-current explosion-proof coal-cutting equipment manufactured by the Jeffrey Manufacturing Co., Columbus, Ohio.

Approval No. 104, covering a 220-volt alternating current explosion-proof coal-cutting equipment manufactured by the Sullivan Machinery Co., Claremont, N. H.

Approval No. 104A, covering a 440-volt alternating-current explosion-proof coal-cutting equipment manufactured by the Sullivan Machinery Co., Claremont, N. H.

PERMISSIBLE PORTABLE ELECTRIC MINE LAMPS.^a

In accordance with Schedule 6A, the following portable electric mine lamps have been approved by this bureau:

Approval No. 10 covers a permissible portable electric mine lamp manufactured by the Edison Storage Battery Co., Orange, N. J.,

^a Unless otherwise specified, all lamps are cap lamps.

to be used with a flexible cord identified by the bureau's specification CD-17. The only bulbs approved for use with this lamp are the symbol BM-10 bulbs, manufactured by the National Lamp Works to the General Electric Co., Cleveland, Ohio; the symbol BM-10 bulbs, manufactured by the Edison Works of the General Electric Co., Harrison, N. J.; and the symbol 26-V bulbs, manufactured by the Miniature Incandescent Lamp Corp., 95 Eighth Avenue, Newark, N. J.

Approval No. 12 covers the Concordia permissible portable electric (hand lamp) mine lamp, manufactured by the Concordia Safety Lamp Co., Fulton Building, Pittsburgh, Pa. The only bulbs approved for use with this lamp are the symbol Osram, 08510 bulbs, sold by the Concordia Safety Lamp Co.

Approval No. 13 and 13-A cover permissible portable electric mine lamps, manufactured by the General Electric Co., Schenectady, N. Y., to be used with a flexible cord identified by the bureau's specification No. CD-21, and with the "ironclad exide battery," manufactured by the Electric Storage Battery Co., Philadelphia, Pa. The only bulbs approved for use with these lamps are the BM-13 bulbs, manufactured by the Edison Lamp Works of the General Electric Co., Harrison, N. J.

Approval No. 14 covers the Wico permissible portable electric mine lamp, manufactured by the Witherbee Igniter Co., Springfield, Mass., to be used with a flexible cord identified by the bureau's specification CD-43. The only bulbs approved for use with this lamp are the symbol BM-14 bulb, manufactured by the Edison Lamp Works of the General Electric Co., Harrison, N. J., and the symbol BM-14 bulbs, manufactured by the National Lamp Works of the General Electric Co., Cleveland, Ohio.

Approval No. 15 covers the Concordia permissible portable electric mine lamp, manufactured by the Concordia Safety Lamp Co., Pittsburgh, Pa., to be used with a flexible cord identified by the bureau's specification CD-17. The only bulbs approved for use with this lamp are the BM-15 bulbs, manufactured by the National Lamp Works of the General Electric Co., Cleveland, Ohio.

Approval No. 16 covers the Pioneer permissible portable electric mine lamp, manufactured by the Pioneer Electric Mine Lamp Co., Philadelphia, Pa., to be used with a flexible cord identified by the bureau's specification No. CD-31, and with battery plates, manufactured by the Electric Storage Battery Co., Philadelphia, Pa. The only bulbs approved for use with this lamp are the BM-16 bulbs, manufactured by the Edison Lamp Works of the General Electric Co., Harrison, N. J., and the symbol BM-16 bulbs, manufactured by the National Lamp Works of the General Electric Co., Cleveland, Ohio.

Approval No. 17 covers the Wheat permissible portable electric mine lamp, manufactured by the Koehler Manufacturing Co. (Inc.), Marlboro, Mass., to be used with a flexible cord identified by the bureau's specification CD-31, and with battery plates, manufactured by the General Lead Battery Co., Newark, N. J. The only bulbs approved for use with this lamp are the BM-17 bulbs manufactured by the National Lamp Works of the General Electric Co., Cleveland, Ohio.

PERMISSIBLE MINERS' (FLAME) SAFETY LAMPS.

In accordance with Schedule 7, the following flame safety lamps have been approved by the bureau:

Approval No. 201 covers a flat-wick steel-frame lamp manufactured by the Koehler Manufacturing Co., Marlboro, Mass.

Approval No. 201-A covers a round-wick steel-frame lamp manufactured by the Koehler Manufacturing Co., Marlboro, Mass.

Approval No. 202 covers a flat-wick steel-frame lamp manufactured by Ackroyd & Best (Ltd.), Arrott Power Building, Pittsburgh, Pa.

Approval No. 203 covers a flat-wick aluminum-frame lamp manufactured by the Koehler Manufacturing Co., Marlboro, Mass.

Approval No. 203-A covers a round-wick aluminum-frame lamp manufactured by the Koehler Manufacturing Co., Marlboro, Mass.

Approvals Nos. 201, 201-A, 203, and 203-A apply only to *magnetic lock* lamps that are equipped with steel gauzes. The only glasses approved for use with these lamps are marked "Macbeth No. 2100 High Speed." The only igniter approved for use with these lamps are the Koehler pyro internal igniter, 1915 model, using a cerium-zinc-copper alloy for igniter points.

Approval No. 202 applies to a magnetic lock lamp. The only glasses approved for use with this lamp are marked as follows:

ACK^o

BEST

A-1

This lamp is relighted electrically. The only relighter approved for this lamp is the Ackroyd & Best underground relighter.

PERMISSIBLE FLASH LAMPS.

In accordance with Schedule 11, the bureau has approved as permissible for use in explosive mixtures of methane and air the Ever-Ready flash lamp manufactured by the American Ever-Ready Works of the National Carbon Co., Long Island City, N. Y. Approval No. 600 has been assigned to this lamp.

PERMISSIBLE EXPLOSIVES TESTED PRIOR TO FEBRUARY 1, 1920.

By SPENCER P. HOWELL.

GENERAL STATEMENT.

In the table following are the brand names of all explosives now considered as permissible explosives that were tested by the Bureau of Mines prior to February 1, 1920.

Further information on permissible explosives may be found in other Bureau of Mines publications.^a The precautions to be observed in the handling, storage, and use of permissible explosives are found in Miner's Circular 6. The conditions to be fulfilled by applicants desiring explosives tested to determine their permissibility for use in coal mines are stated in Schedule 1. A description of the tests made, the apparatus used for such tests, and detailed results of tests of 100 permissible explosives are given in Bulletins 15 and 66. The storage, handling, and use of permissible explosives are discussed in Bulletins 10 and 17 and Miner's Circular 7, and the methods used by the bureau in the analysis of permissible explosives and the tolerances for permissible explosives as promulgated by the Bureau of Mines on July 1, 1915, are detailed in Bulletin 96. The tolerances established are also given on pages 77 and 78 of the present report.

There were 152 explosives on the permissible list on January 1, 1917.^b During the succeeding 34 months 30 explosives were added to the list; 7 explosives were dropped (in most instances because the manufacturers no longer desired to market them) and are no longer designated permissible explosives. The present list takes the place of all preceding lists and includes a total of 175 explosives.

Additions to this list of permissible explosives will be published in future issues of the Monthly Statement of Coal-Mine Fatalities in the United States, which contains also lists of miners' electric lamps and other devices approved by the Bureau of Mines.

^a Hall, Clarence, Permissible explosives tested prior to Jan. 1, 1912, and precautions to be taken in their use: Miner's Circular 6, Bureau of Mines, 1912, 20 pp.; Fees for testing explosives: Schedule 1, Bureau of Mines, 1913; Hall, Clarence, Snelling, W. O., and Howell, S. P., Investigations of explosives used in coal mines: Bull. 15, Bureau of Mines, 1911, 191 pp.; Hall, Clarence, and Howell, S. P., Tests of permissible explosives: Bull. 66, Bureau of Mines, 1913, 313 pp.; Munroe, C. E., and Hall, Clarence, A primer on explosives for coal miners: Bull. 17, Bureau of Mines, 1911, 61 pp.; Rutledge, J. J., and Hall, Clarence, The use of permissible explosives: Bull. 10, Bureau of Mines, 1912, 34 pp.; Storm, C. G., The analysis of permissible explosives: Bull. 96, Bureau of Mines, 1916, 88 pp.; Rutledge, J. J., The use and misuse of explosives in coal mining: Miner's Circular 7, Bureau of Mines, 1913, 52 pp.; Howell, S. P., and Tiffany, J. E., Methods for routine work in the explosives physical laboratory of the Bureau of Mines: Tech. Paper 186, Bureau of Mines, 1918, 63 pp.

^b Howell, S. P., Permissible explosives tested prior to Jan. 1, 1917: Tech. Paper 169, Bureau of Mines, 1917, 19 pp.

DEFINITION OF A PERMISSIBLE EXPLOSIVE.

An explosive is called a permissible explosive when it is similar in all respects to the sample that passed certain tests by the Federal Bureau of Mines, and when it is used in accordance with the conditions prescribed by this bureau. But even the explosives that have passed these tests and are named in this list as permissible explosives are to be considered permissible explosives only when used under the following conditions:

1. That the explosive is in all respects similar to the sample submitted by the manufacturer for test.

2. That denotators—preferably electric detonators—are used of not less efficiency than those prescribed, namely, those consisting by weight of 90 parts of mercury fulminate and 10 parts of potassium chlorate (or their equivalents).

3. That the explosive, if frozen, shall be thoroughly thawed in a safe and suitable manner before use.

4. That the quantity used for a shot does not exceed $1\frac{1}{2}$ pounds (680 grams), and that it is properly tamped with clay or other non-combustible stemming.

After an explosive has passed the required tests and its brand name has been published in a list of permissible explosives, it is not a permissible explosive if one or more of any of the following conditions prevail:

1. If kept in a moist place until it undergoes a change in character.
2. If used in a frozen or partly frozen condition.
3. If used in excess of $1\frac{1}{2}$ pounds (680 grams) per shot.
4. If the diameter of the cartridge is less than that designated in the column "smallest permissible diameter."
5. If fired with a detonator or electric detonator of less efficiency than that prescribed.
6. If fired without stemming.
7. If fired with combustible stemming.

Moreover, even when all of the prescribed conditions have been met, no explosive on the permissible list should necessarily be considered as being *permanently* a permissible explosive, for the bureau reserves the right, on fuller information concerning the conditions that lead to safety, to revise this list; but any permissible explosive when used under the prescribed conditions may properly continue to be considered a permissible explosive until notice of its withdrawal or removal from the list has been officially published, or until its name is omitted from a later list published by the Bureau of Mines.

Furthermore, the manufacturers of a permissible explosive may withdraw it at any time. Manufacturers are urged to do so when replacing a permissible explosive by one of superior qualities, or when

they permanently discontinue the manufacture of a permissible explosive.

After further experiments and conferences the Bureau of Mines may find it advisable to adopt additional and more severe tests to which all permissible explosives may be subjected, in the hope that through the use of such explosives only as pass the more severe tests the lives of miners may be better safeguarded.

LIST OF PERMISSIBLE EXPLOSIVES.

Subject to the conditions and provisions stated herein, the following explosives are classed as permissible explosives:

Permissible explosives tested prior to Feb. 1, 1920.

Brand.	Class designation basis, volume of poisonous gases.	Class designation basis, characteristic ingredient.	When used with detonators, preferably electric detonators, of not less efficiency than—	Weight of 11 by 8 inch cartridge.	Smallest permissible diameter.	Unit defective charge.	Rate of detonation in 11-inch diameter cartridges.		Manufacturer.
							Feet per second.	Meters per second.	
1	2	3	4	5	6	7	8	9	
Actna coal powder A.....	C.....	4.....	No. 6.....	Grams. 181	Inches. 1 1/4	Grams. 277	12,020	3,818	Actna Explosives Co. (Inc.), New York, N. Y.
Actna coal powder A.....	A.....	1a.....	do.....	a 214	1 1/4	211	7,580	2,303	Do.
Actna coal powder B.....	C.....	4.....	do.....	179	1 1/4	301	9,870	3,008	Do.
Actna coal powder C.....	B.....	do.....	do.....	198	1 1/4	314	7,010	2,138	Do.
Actna coal powder 2.....	A.....	1a.....	do.....	186	1 1/4	212	9,280	2,830	Do.
Bental coal powder No. 2.....	A.....	do.....	No. 7.....	180	1 1/4	276	4,750	1,447	Hercules Powder Co., Wilmington, Del.
Bental coal powder No. 2-X.....	A.....	do.....	No. 6.....	192	1 1/4	280	7,980	2,432	Do.
Big Red No. 1.....	B.....	do.....	do.....	171	1 1/4	210	7,250	2,209	The Equitable Powder Manufacturing Co., and the Egyptian Powder Co., East Alton, Ill.
Big Red No. 2.....	B.....	do.....	do.....	166	1 1/4	255	10,850	3,309	Do.
Big Red No. 4, L, F.....	B.....	do.....	do.....	171	1 1/4	251	10,200	3,138	Do.
Big Red No. 5.....	A.....	do.....	do.....	182	1 1/4	210	7,400	2,281	Do.
Big Red No. 6, L, F.....	B.....	do.....	do.....	171	1 1/4	212	7,180	2,280	Do.
Big Red No. 7.....	B.....	do.....	do.....	183	1 1/4	227	10,400	3,150	Do.
Bituminite 1.....	C.....	4.....	do.....	187	1 1/4	318	12,800	3,901	Actna Explosives Co. (Inc.), New York, N. Y.
Bituminite 4.....	C.....	do.....	do.....	178	1 1/4	301	7,510	2,308	Do.
Bituminite 5.....	A.....	do.....	do.....	176	1 1/4	251	9,120	2,782	Do.
Bituminite 8, L, F.....	A.....	1a.....	do.....	155	1 1/4	303	9,300	2,831	Do.
Black Diamond No. 2-A.....	C.....	do.....	do.....	190	1 1/4	281	12,000	3,612	Illinois Powder Manufacturing Co., St. Louis, Mo.
Black Diamond No. 3-A.....	C.....	do.....	do.....	156	1 1/4	234	11,160	3,402	Do.
Black Diamond No. 5.....	A.....	1a.....	do.....	180	1 1/4	288	6,020	1,835	Do.
Black Diamond No. 6, L, F.....	C.....	4.....	do.....	158	1 1/4	306	9,630	2,935	Do.
Black Diamond No. 7.....	A.....	1a.....	do.....	183	1 1/4	211	10,730	3,270	Do.
Black Diamond No. 8.....	B.....	4.....	do.....	168	1 1/4	215	8,730	2,663	Do.
Cameron mine powder No. 1-A.....	A.....	1a.....	do.....	156	1 1/4	227	10,950	3,339	Grasselli Powder Co., Cleveland, Ohio.
Cameron mine powder No. 2-A.....	A.....	do.....	do.....	a 224	1 1/4	230	610,520	3,206	Do.
Cameron mine powder No. 2-A, J, F.....	A.....	do.....	do.....	215	1 1/4	233	10,350	3,138	Do.
Cameron mine powder No. 3-A.....	C.....	4.....	do.....	192	1 1/4	296	10,330	3,133	Do.
Cameron mine powder No. 5-A.....	C.....	do.....	do.....	226	1 1/4	299	8,900	2,712	Do.

Carbonite No. 1.	C	do.	do.	do.	226	11	280	100,950	3,335	E. I. du Pont de Nemours & Co., Wilmington, Del.
Carbonite No. 2.	C	do.	do.	do.	170	1	302	11,380	3,470	Do.
Carbonite No. 2, L. F.	C	do.	do.	do.	180	1	305	7,830	2,387	Do.
Carbonite No. 3.	C	do.	do.	do.	174	1	325	8,710	2,656	Do.
Carbonite No. 4.	C	do.	do.	do.	200	1	327	7,670	2,339	Do.
Carbonite No. 5.	C	do.	do.	do.	175	1	304	10,110	3,092	Do.
Carbonite No. 6.	C	do.	do.	do.	175	1	315	7,490	2,285	Do.
Coalite X.	A	1a.	do.	do.	155	1	226	9,000	2,745	Atlas Powder Co., Wilmington, Del.
Coalite Y.	B	do.	do.	do.	164	1	235	10,300	3,111	Atlas Powder Co. (Con.), Giant, Cal.
Coalite No. 1.	C	4.	do.	do.	232	11	296	7,990	2,418	Do.
Coalite No. 2-D.	B	do.	do.	do.	233	1	310	8,430	2,571	Do.
Coalite No. 2-D, L.	C	do.	do.	do.	116	1	271	7,340	2,237	Do.
Coalite No. 2-M, L. F.	C	do.	do.	do.	157	1	301	9,220	2,811	Do.
Coalite No. 2-M, L. F.	C	1a.	do.	do.	164	1	250	8,330	2,536	Atlas Powder Co., Wilmington, Del.
Coalite No. 3-XC	B	do.	do.	do.	161	1	250	9,670	2,939	Atlas Powder Co. (Con.), Giant, Cal.
Coalite No. 3-YC	B	do.	do.	do.	162	1	250			Atlas Powder Co. (Con.), Giant, Cal.
Coal special 1-A.	C	4.	do.	do.	148	1	276	9,370	2,857	Acma Explosives Co. (Inc.), New York, N. Y.
Coal special 1, L. F.	C	do.	do.	do.	160	1	277	8,280	2,524	Do.
Coal special 2-W.	C	do.	do.	do.	180	1	277	11,590	3,534	Do.
Coal special 3-C.	C	do.	do.	do.	192	1	288	9,760	2,977	Do.
Collier A.	C	1a.	do.	do.	160	1	215	11,280	3,440	Do.
Collier B.	B	do.	do.	do.	156	1	207	10,970	3,345	Do.
Collier C.	B	do.	do.	do.	175	1	222	11,610	3,539	Do.
Collier Y.	C	do.	do.	do.	172	1	229	9,740	2,970	Do.
Collier X, L. F. 1.	B	do.	do.	do.	164	1	237	8,140	2,483	Do.
Collier X, L. F. 2.	B	do.	do.	do.	165	1	228	9,950	3,035	Do.
Collier 5.	A	do.	do.	do.	178	1	240	8,240	2,524	Do.
Collier 5, special.	A	do.	do.	do.	180	1	295	8,330	2,511	Do.
Collier 6.	A	do.	do.	do.	169	1	214	11,220	3,422	Do.
Collier 11.	A	do.	do.	do.	165	1	217	11,680	3,561	Do.
Collier 11, L. F.	B	do.	do.	do.	180	1	226	10,850	3,198	Do.
Gronite No. 1.	B	do.	do.	do.	149	1	233	10,400	3,088	G. R. McAbee Powder & Oil Co., Pittsburgh, Pa.
Gronite No. 5.	B	do.	do.	No. 7.	165	1	219	8,000	2,463	Do.
Duolet No. 5.	B	do.	do.	No. 6.	143	1	213	10,960	3,211	Do.
Du 1 ont 1 inmissible No. 1.	B	do.	do.	do.	175	1	278	9,610	2,800	E. I. du Pont de Nemours & Co., Wilmington, Del.
Eureka No. 2.	B	2.	do.	do.	190	1	311	10,720	3,249	Do.
Franklinite 1.	B	4.	do.	do.	192	1	288	9,760	2,977	G. R. McAbee Powder & Oil Co., Pittsburgh, Pa.
Franklinite 4.	B	do.	do.	do.	198	1	314	7,010	2,138	Acma Explosives Co. (Inc.), New York, N. Y.
Fuelite No. 3.	B	1a.	do.	do.	179	1	215	8,500	2,138	Do.
Fuelite No. 3, L. F.	B	do.	do.	do.	172	1	229	10,810	2,620	Do.
General A.	C	4.	do.	do.	204	1	274	13,500	4,116	General Explosives Co., Joplin, Mo.
General B.	C	do.	do.	do.	187	1	289	10,640	3,214	Do.
General C.	B	do.	do.	do.	186	1	304	10,460	3,190	Do.
General 1.	A	1a.	do.	do.	168	1	208	10,650	3,217	Do.
General 3-X.	A	do.	do.	do.	203	1	230	8,930	2,730	Do.
General 4.	A	do.	do.	do.	170	1	227	10,920	3,330	Do.
General 6-X.	B	do.	do.	do.	194	1	220	10,510	3,294	Do.
Giant coal mine powder No. 5.	B	do.	do.	do.	157	1	228	10,230	3,118	Giant Powder Co. (Con.), Giant, Calif.

b 1½-inch diameter cartridge.

a 14 by 5 inch cartridge.

Lowinote No. 2-B.	A.	1a.	148	11	258	9, 710	2, 971	Lowinote Explosives Manufacturing Co., Pitts-
Mine-ite A.	B.	4.	183	11	296	11, 290	3, 453	burgh, Pa.
Mine-ite A-2.	C.	do.	156	11	319	10, 670	3, 252	Crassell Powder Co., Cleveland, Ohio.
Mine-ite B.	C.	do.	168	11	340	9, 510	2, 908	Do.
Mine-ite No. 5, D.	A.	1a.	161	11	241	8, 720	2, 658	Do.
Mine-ite No. 6, D.	B.	do.	169	11	224	8, 000	2, 467	Do.
Miners' Friend No. 1.	B.	do.	167	11	223	11, 580	3, 529	Atlas Powder Co., Wilmington, Del.
Miners' Friend No. 2.	B.	do.	166	11	242	10, 330	3, 149	Do.
Miners' Friend No. 3.	B.	do.	167	11	242	8, 000	2, 449	Do.
Miners' Friend No. 4.	B.	do.	167	11	242	9, 980	3, 014	Do.
Miners' Friend No. 5.	B.	do.	166	11	250	8, 570	2, 614	Do.
Miners' Friend No. 6.	B.	do.	166	11	254	10, 490	2, 824	Do.
Miners' Friend No. 7.	B.	do.	176	11	253	8, 930	2, 729	Do.
Miners' Friend No. 8, L. F.	A.	do.	193	11	421	9, 600	3, 417	Do.
Monohel Y.	B.	4.	168	11	232	9, 300	2, 835	E. I. du Pont de Nemours & Co., Wilmington, Del.
Monohel No. 1.	B.	do.	179	11	216	11, 700	3, 568	Do.
Monohel No. 2.	B.	do.	178	11	239	9, 870	3, 009	Do.
Monohel No. 3.	B.	do.	174	11	243	7, 200	2, 212	Do.
Monohel No. 4.	B.	do.	174	11	218	8, 980	2, 738	Do.
Monohel No. 5.	B.	do.	179	11	207	6, 700	2, 061	Do.
Monohel No. 6.	B.	do.	175	11	218	10, 380	3, 165	Do.
Monohel No. 7.	B.	do.	180	11	211	10, 050	3, 065	Do.
Nitro low-dumme No. 1.	C.	4.	234	11	303	33, 380	4, 079	Nitro Powder Co., Kingston, N. Y.
Nitro low-dumme No. 2.	C.	do.	226	11	298	34, 560	4, 439	Do.
Red H No. 1.	B.	1a.	167	11	246	11, 700	3, 568	Herules Powder Co., Wilmington, Del.
Red H No. 2.	B.	do.	180	11	239	9, 870	3, 009	Do.
Red H No. 3.	B.	do.	173	11	243	7, 200	2, 212	Do.
Red H No. 4.	B.	do.	164	11	248	8, 980	2, 738	Do.
Red H No. 5.	B.	do.	164	11	207	6, 700	2, 061	Do.
Red H No. 6.	B.	do.	162	11	218	10, 380	3, 165	Do.
Red H No. 7.	B.	do.	180	11	211	10, 050	3, 065	Do.
Red H No. 8.	B.	do.	161	11	278	7, 500	2, 313	Do.
Trojan coal powder H.	A.	3.	218	11	334	9, 130	2, 872	Pennsylvania Trojan Powder Co., Allentown, Pa.
Trojan coal powder I.	A.	do.	218	11	410	9, 620	2, 931	Do.
Trojan coal powder J.	A.	do.	229	11	360	10, 330	3, 230	Do.
Trojan coal powder K.	B.	do.	181	11	314	10, 380	3, 161	Do.
Trojan coal powder L.	B.	do.	166	11	275	10, 560	3, 221	Do.
Trojan granular coal powder No. 1.	A.	do.	2 217	11	295	m 7, 920	m 2, 416	Do.
Tumulte AA.	A.	1a.	176	11	253	7, 690	2, 366	G. R. McAbee Powder & Oil Co., Pittsburgh, Pa.
Tumulte B.	B.	do.	167	11	249	9, 990	3, 047	Do.
Tumulte C.	A.	do.	187	11	255	10, 060	3, 068	Do.
Tumulte No. 3.	A.	4.	150	11	291	10, 110	3, 083	Do.
Tumulte No. 4.	C.	do.	136	11	309	10, 620	3, 298	Do.
Tumulte No. 5.	C.	do.	176	11	328	8, 400	2, 562	Do.
Tumulte No. 6.	C.	do.	172	11	305	9, 670	2, 947	Do.
Tumulte No. 6, L. F.	C.	do.	156	11	301	9, 620	2, 933	Do.

Same as corresponding brands of Fuel-ites.

Same as Mine-ite A. D.

Same as Mine-ite 6 D.

Same as Cameron mine powder No. 1-A.

Same as corresponding brands of Mine-ites.

Same as Mine-ite A. 2.

Same as Cameron mine powder No. 3-A.

Same as Cameron mine powder No. 1-A.

1 1/2-inch diameter cartridge.

Same as corresponding brands of Black Diamond.

1 1/4 by 8 inch cartridge.

1 1/2-inch diameter cartridge.

Permissible explosives tested prior to Feb. 1, 1920—Continued.

Brand.	1	Class designation basis, volume of poisonous gases.	Class designation basis, characteristic ingredient.	When used with detonators, preferably electric detonators, of not less efficiency than—	Weight of 1 1/2 by 8 inch cartridge.	Smallest permissible diameter.	Unit defective charge.	Rate of detonation in 1 1/2-inch diameter cartridges.		Manufacturer.
								Feet per second.	Meters per second.	
	1			4	3	6	7	8	9	
Tunnelite No. 7.....		C.....	4.....	No. 6.....	164	1 1/2	311	8,720	2,659	G. R. McAbee Powder & Oil Co., Pittsburgh, Pa.
Tunnelite No. 8.....		C.....	do.....	do.....	158	1 1/2	324	8,020	2,446	Do.
Tunnelite No. 8, L. F.....		C.....	do.....	do.....	176	1 1/2	322	8,720	2,658	Do.
Vigorite No. 1.....		C.....	do.....	do.....	204	1 1/2	259	10,950	3,338	Atlas Powder Co., Wilmington, Del., and the Giant Powder Co. (Con.), Giant, Calif.
Vigorite No. 2.....		C.....	do.....	do.....	168	1 1/2	298	10,920	3,330	Do.
Vigorite No. 3.....		B.....	do.....	do.....	160	1 1/2	320	8,140	2,483	Do.
Vigorite No. 4.....		B.....	do.....	do.....	200	1 1/2	341	7,480	2,281	Do.
Vigorite No. 5.....		C.....	do.....	do.....	165	1 1/2	304	10,800	3,303	Do.
Vigorite No. 6.....		C.....	do.....	do.....	166	1 1/2	345	7,480	2,283	Do.
Xpdlite No. 1.....		C.....	do.....	do.....	211	1 1/2	259	10,960	3,388	Hercules Powder Co., Wilmington, Del.
Xpdlite No. 2.....		C.....	do.....	do.....	168	1 1/2	302	11,380	3,470	Do.
Xpdlite No. 3.....		C.....	do.....	do.....	162	1 1/2	325	8,710	2,656	Do.
Xpdlite No. 4.....		C.....	do.....	do.....	190	1 1/2	327	7,670	2,339	Do.
Xpdlite No. 5.....		C.....	do.....	do.....	166	1 1/2	304	10,140	3,092	Do.
Xpdlite No. 6.....		C.....	do.....	do.....	165	1 1/2	345	7,490	2,285	Do.

CLASSES OF PERMISSIBLE EXPLOSIVES.

In order that the user of explosives may be able the better to select an explosive to meet a specific requirement the Bureau of Mines now classifies permissible explosives in two ways, as follows: (1) On the basis of the volume of poisonous gases produced by $1\frac{1}{2}$ pounds (680 grams) of the explosive, and (2) on the basis of the characteristic ingredient of each explosive.

VOLUME OF POISONOUS GASES.

Most permissible explosives when properly detonated in a drill hole in a coal mine produce poisonous gases, but they produce at the same time a much larger volume of nonpoisonous gases. In order that the poisonous gases may not under normal conditions become a menace to the lives or health of miners no explosive is now or can become permissible if it evolves upon detonation more than 158 liters ($5\frac{1}{2}$ cubic feet) of permanent poisonous gases, as determined by test in the Bichel pressure gage. Field tests of an explosive made under extreme conditions for the production of the greatest percentage of poisonous gases in the air show that in a narrow entry, with no ventilation at or near the face, a $1\frac{1}{2}$ -pound charge of an explosive, which gave 158 liters of poisonous gas in gage tests, produced 0.18 per cent of carbon monoxide (the only poisonous gas present) in the air when the sample was taken two minutes after the shot. Another sample of the air taken two minutes later contained 0.08 per cent of carbon monoxide. It is therefore evident that where ventilation is not active, as in a closed heading, miners or shot firers should not return to the face until at least five minutes after a shot. At all working faces that are difficult to ventilate explosives of class A or class B should be used, preferably those of class A.

The classification on the basis of the volume of poisonous gases produced by $1\frac{1}{2}$ pounds (680 grams) of the explosive is as follows:

Class A, those explosives from which the volume of poisonous gases produced is not more than 53 liters.

Class B, those explosives from which the volume of poisonous gases is more than 53 liters but less than 106 liters, inclusive.

Class C, those explosives in which the volume of poisonous gases is more than 106 liters but less than 158 liters, inclusive.

CHARACTERISTIC INGREDIENTS.

Explosives are classified in accordance with their characteristic ingredient as follows:

Class 1, ammonium nitrate explosives.—To class 1 belong all the explosives in which the characteristic ingredient is ammonium nitrate.

This class is divided into two subclasses. Subclass A includes every ammonium nitrate explosive that contains a sensitizer that is in itself an explosive. Subclass B includes every ammonium nitrate explosive that contains a sensitizer that is not in itself an explosive. The ammonium nitrate explosives of subclass A consist principally of ammonium nitrate with small percentages of nitroglycerin, nitrocellulose, or nitrosubstitution compounds which are used as sensitizers. The ammonium nitrate explosives of subclass B consist principally of ammonium nitrate with small percentages of resinous matter or other nonexplosive substances used as sensitizers.

Ammonium nitrate explosives, when fresh and properly denotated, are well adapted for use in mines that are not unusually wet. They are not suitable for use in wet mines, for if the contents of a cartridge of ammonium nitrate explosive is exposed for only a few hours to the damp atmosphere the explosive may so deteriorate as to fail to detonate completely, because ammonium nitrate takes up moisture readily. The redipping of cartridges of ammonium nitrate explosives aids in protecting the contents against moisture, or moist air, and the cartridges should be so stored and handled as to preserve the efficacy of the paraffinlike coating. The explosives should be obtained in a fresh condition and purchased in such quantities as will permit their prompt use. Experience at the Pittsburgh experiment station of the bureau shows that ammonium nitrate explosives will usually detonate completely after storage for six months in a well-ventilated magazine.

Class 2, hydrated explosives.—To class 2 belong all explosives in which salts containing water of crystallization are the characteristic ingredients. The explosives of this class are somewhat similar in composition to the ordinary low-grade dynamites, except that one or more salts containing water of crystallization are added to reduce the flame temperature. They are easily detonated, and most of them can be used successfully in damp working places.

Class 3, organic nitrate explosives.—To class 3 belong all the explosives in which the characteristic ingredient is an organic nitrate other than nitroglycerin. The permissible explosives now listed under class 3 are nitrostarch explosives.

Class 4, nitroglycerin explosives.—To class 4 belong all the explosives in which the characteristic ingredient is nitroglycerin. These explosives contain free water or an excess of carbon, which is added to reduce the flame temperature. A few explosives of this class contain salts, or an unusually low percentage of nitroglycerin, that reduce the strength and shattering effect of the explosives on detonation. The nitroglycerin explosives have the advantages of detonating easily and of not being readily affected by moisture.

WEIGHT OF $1\frac{1}{4}$ BY 8 INCH CARTRIDGE.

The size in which cartridges of permissible explosives are usually sold is $1\frac{1}{4}$ by 8 inches, and from the weight of a cartridge of this size as given in the table the number of cartridges required to make the 680 grams ($1\frac{1}{2}$ pounds) maximum permissible quantity of explosive in a shot may be readily determined. To illustrate, the first explosive on the accompanying list (Aetna coal powder A), like all the other explosives on the list, is permissible only when fired in charges not exceeding 680 grams ($1\frac{1}{2}$ pounds). The maximum permissible weight per shot (680 grams), divided by the weight of one $1\frac{1}{4}$ by 8 inch cartridge (184 grams for Aetna coal powder A), gives the maximum permissible number of cartridges of this size that may be used, $3\frac{5}{8}$ (or 3.69) cartridges.

SMALLEST PERMISSIBLE DIAMETER.

In order that the user may know readily the smallest diameter in which a given explosive is permissible, this information is given in the table. Should a manufacturer desire that an explosive be approved as permissible in a smaller diameter than that in which it is now permissible, he should make application for the necessary tests.

UNIT DEFLECTIVE CHARGE AS DETERMINED BY THE BALLISTIC PENDULUM.

The figures in the seventh column of the table show the weight in grams of the quantity of explosive that is required to swing the pendulum mortar the same distance as one-half pound (227 grams) of the standard 40 per cent "straight" nitroglycerin dynamite of the Pittsburgh testing station of the Bureau of Mines. Many observers have expressed the opinion that the "coal-getting" strength of permissible explosives is represented better by the results of this test than by the results of any other single test yet devised. The reader should note that the results do not take into consideration whether the coal when shot down is fine or coarse.

In comparing the unit deflective charge of one explosive with that of another explosive a fine distinction should not be drawn, for it must be remembered that tolerance limits have been established for the results with the ballistic pendulum, as given on page 78, and these limits are designed to cover all reasonable variations of manufacture, sampling, and chemical and physical determinations made. This principle applies to all the items of the chemical analysis as well as to the items of the physical tests.

RATE OF DETONATION.

The table shows in feet per second and meters per second the relative velocity of detonation of each explosive. The adaptability of a permissible explosive to a particular coal-mining condition depends greatly on its rate of detonation. For certain work in which a shattering effect is desired, as in driving through or "brushing" rock, or in producing coal for coke making, the explosive reaction should be rapid, and for such work permissible explosives having a high rate of detonation should be selected. Similarly, for shooting down a soft, friable coal to produce lump or steam coal, a permissible explosive should be selected that detonates slowly and hence gives a more prolonged pressure. In medium hard coal an explosive having an intermediate rate of detonation may be expected to be most suitable.

Although these relations usually hold, they do not always, because coals differ in hardness and coal beds differ in the number and position of the joints, partings, and shale bands. Such facts have to be considered in selecting an explosive for mining coal.

An explosive having a very low rate of detonation is not always the best for mining a friable coal much fractured, because some of its energy may be lost by its gases escaping through the fractures. Under such conditions an explosive having an intermediate rate produces the most economical results.

STORAGE OF PERMISSIBLE EXPLOSIVES.

The bureau is now reexamining permissible explosives found in commercial shipments and in the field to determine how closely they conform to the samples upon which the permissibility tests were originally made. In order that this examination should be properly made, tolerances^a were established by the bureau on July 1, 1915.

One of the provisions of these tolerances is "that where the Bureau of Mines finds a sample which does not come up to the tolerance limits, the bureau shall simply declare that particular lot of explosives not permissible, and a copy of the notification to the consumer or owner shall be furnished the manufacturer."

The usual causes of an explosive exceeding the tolerances for chemical analysis or physical tests are two: (1) It may not have been properly manufactured; (2) it may not have been properly stored. The manufacturer is responsible for 1 because the consumer has no control over the method of manufacture of the explosive, but the consumer or owner is responsible for 2 because the manufacturer has no control over the conditions of storage when the explosive has

^a Storm, C. G., The analysis of permissible explosives: Bull. 96, Bureau of Mines, 1916, pp. 80-81.

once passed from his ownership. When a given lot of explosive is declared nonpermissible both the owner and the manufacturer are notified. The bureau does not attempt to fix the responsibility as between owner and manufacturer.

The manufacturer should exercise due care that the quality of the raw materials, and the weighing and incorporating of them is similar in all respects to that for the original sample of explosives submitted for tests; and that the explosive is fresh and in first-class condition when sold. The user should store explosives in well-ventilated magazines, at temperatures not exceeding 90° F. The boxes should be placed so that the cartridges lie horizontally, though the tops of the boxes may be up or down. The explosives purchased first should be used first, and hence older explosives should not be stored under or behind a fresh consignment. It is well to purchase explosives in such quantities that they can be used promptly.

TOLERANCES FOR PERMISSIBLE EXPLOSIVES.

The tolerances promulgated by the Bureau of Mines to provide for reasonable limits of variation in the results of analyses and tests of permissible explosives are given below. If these tolerances are exceeded by a given lot of any permissible explosive it is not permissible. The tolerances established, which were made effective July 1, 1915, and were first published in Bulletin 96, as previously stated, are as follows:

In order to define more exactly what is meant by the phrase "similar in all respects" in the definition of a permissible explosive, namely, "an explosive is called a permissible explosive when it is similar in all respects to the sample that passed certain tests by the United States Bureau of Mines, and when it is used in accordance with the conditions prescribed by this bureau," the following tolerances are recommended for field samples or manufacturers' samples of explosives, beyond which such lot of explosives can not vary and still be considered permissible for use in coal mines: *Provided*, That where the Bureau of Mines finds a sample which does not come up to the tolerance limits, the bureau shall simply declare that particular lot of explosives not permissible, and a copy of the notification to the consumer or owner shall be furnished the manufacturer, the notification to state that the explosive did not meet the tolerance requirements for moisture or ingredients, etc., as the case might be.

Chemical analysis.—Moisture, to be fixed by a sliding scale of from 1½ per cent at zero to 4 per cent at 10 per cent of moisture in original sample, this tolerance being on total percentage of moisture in the explosive.

Other ingredients (or their equivalents) in quantities not exceeding 60 per cent, according to curve shown in figure 1. For ingredients in quantities of 60 per cent or more, the tolerance shall be plus or minus 3 per cent: *Provided*, That the ingredients of a permissible explosive shall be considered to be those substances reported as found by the Bureau of Mines in the original sample of that explosive submitted for test as to its permissibility: *And provided further*, That an equivalent shall be considered to be a substance which would not materially alter the properties of the explosive and which would produce the same result as the original substance.

Products of combustion (determined by Bichel gage tests).—The volume of poisonous gases from 680 grams of the explosive, including its wrapper, must be less than 158 liters, except that in case the first test yields 158 liters or more of poisonous gases per 680 grams of the explosive, including its wrapper, the average result of three tests agreeing within 5 per cent of each other shall be taken, and no explosive shall remain permissible when this average for poisonous gases exceeds the above standard limits.

Physical tests.^a—

Rate of detonation (the average of three trials with Mettegang's recorder), plus or minus 15 per cent.

Unit defective charge (the average of three trials with the ballistic pendulum), plus or minus 10 per cent.

Grams of wrapper per 100 grams of explosive, plus or minus 2.0 grams (average of four determinations): *Provided*, That the manufacturers shall submit samples of all different sizes of cartridges, to be considered as part of the original sample, the amount of wrapper to be determined for each size of sample: *And provided further*, That the tolerances as suggested shall be determined in comparison with the various diameters of samples as submitted with the original sample.

Apparent specific gravity of cartridge, by sand, plus or minus 7.5 per cent (average of four determinations): *Provided*, That actual density shall be determined on cartridges of the same diameter as the standard: *And provided further*, That manufacturers shall be required to submit samples of all sizes.

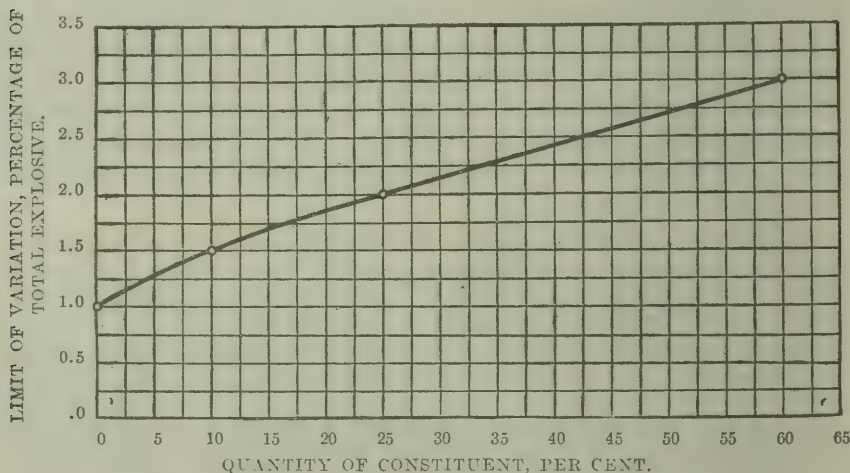


FIG. 1.—Curve of limit variation in composition of permissible explosives.

Gas and dust gallery No. 1.—No ignition must be obtained in each of one or more trials. Note: In the retesting of permissible explosives by tests 1, 3, and 4,^b the charges of the explosives fired will be reduced 10 per cent in weight from the weights originally used in order to eliminate any likelihood of a failure being due to the natural variations in the gallery conditions.

Pendulum friction test.—Each explosive must pass a test of 10 trials under the same conditions as originally tested, except that the height of fall of the wood-fiber shoe will be reduced by 10 per cent in order to eliminate any likelihood of a failure being due to the natural variations in test conditions.

^a For method of making these tests, see Howell, S. P., and Tiffany, J. E., *Methods for routine work in the explosives physical laboratory of the Bureau of Mines*: Tech. Paper 186, Bureau of Mines, 1918, 63 pp.

^b Work cited p. 303.

STATE MINE INSPECTORS AND OTHER MINE OFFICIALS IN THE UNITED STATES.

January 1, 1920.

ALABAMA.

Name.	Designation.	Address.
Charles H. Nesbitt.....	Chief mine inspector.....	419-423 Chamber of Commerce, Birmingham.
E. E. Echols.....	Assistant mine inspector, district No. 1.....	Tombloosa.
David Kelo.....	Assistant mine inspector, district No. 2.....	Wylan.
Hugh Lynch.....	Assistant mine inspector, district No. 3.....	Fruit City.
S. M. Thompson.....	Assistant mine inspector, district No. 4.....	Helena.
R. V. Huff.....	Assistant mine inspector, district No. 5.....	Gadsden.
John R. Smith.....	Assistant mine inspector, district No. 6.....	Jasper.

ALASKA.

Sumner S. Smith.....	United States mine inspector.....	Eska (care of Alaskan Engineering Commission).
B. D. Stewart.....	Territorial mine inspector.....	Juneau.

ARIZONA.

G. M. Butler.....	Director, State bureau of mines.....	Tucson.
G. H. Bolin.....	State mine inspector.....	Phoenix.
Edward Massey.....	Deputy mine inspector.....	Bisbee.
John Harper.....	do.....	Globe.
J. C. Wilson.....	do.....	Kingman.

ARKANSAS.

Jas. G. Ferguson.....	Commissioner of mines, manufactures, and agriculture.	Little Rock.
John T. Fuller.....	State mineralogist.....	Do.
Thomas H. Shaw.....	State mine inspector.....	Rooms 413-414 First National Bank Building, Fort Smith.

CALIFORNIA.

A. J. Pillsbury.....	Chairman, industrial accident commission.....	525 Market Street, San Francisco.
W. P. Rediff.....	Chief statistician.....	Do.
H. M. Wolfelin.....	Superintendent of safety.....	Underwood Building, San Francisco.
G. Chester Brown.....	Chief mining engineer.....	525 Market Street, San Francisco.
J. Wesley Gebb.....	Mining engineer.....	Underwood Building, San Francisco.
F. L. Lowell.....	do.....	525 Market Street, San Francisco.
F. McN. Hamilton.....	State mineralogist.....	Ferry Building, San Francisco.
E. S. Bealich.....	Mining engineer, California State mining bureau.	Do.

COLORADO.

	<i>Metal mines.</i>	
Horace F. Lunt.....	Commissioner, bureau of mines, State of Colorado.	Denver.
Vincent C. Perini, Jr.....	Secretary.....	Do.
T. R. Honahan.....	Inspector, district No. 1.....	Do.
M. J. McCarthy.....	Inspector, district No. 2.....	Cripple Creek.
R. J. Murray.....	Inspector, district No. 3.....	Leadville.
Robert Innes.....	Inspector, district No. 4.....	Montrose.

COLORADO—Continued.

Name.	Designation.	Address.
<i>Coal mines.</i>		
James Dalrymple.....	Chief inspector of coal mines.....	State Capitol, Denver.
Frank N. Oberding.....	Deputy inspector.....	Louisville.
Henry King.....	do.....	Denver.
James W. Graham.....	do.....	Lafayette.
James Dalrymple, jr.....	do.....	Trinidad.
W. H. James.....	do.....	Walsenberg.
Joseph Cochrane.....	do.....	Aguilar.

IDAHO.

Robert N. Bell.....	State mine inspector, mining department.....	Boise.
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ILLINOIS.

Joseph C. Thompson....	Director, department of mines and minerals....	Springfield.
Martin Bolt.....	Assistant director.....	1600 South College Street, Springfield.
F. C. Weiss.....	Chief clerk.....	Springfield.
William Hutton.....	Member, State mining board.....	Duquoin.
Peter Joyce.....	do.....	Springfield.
M. S. Coleman.....	do.....	Harrisburg.
James Needham.....	do.....	Chicago.
William Hall.....	President, miners' examining board.....	Springfield.
William H. Turner.....	Member, miners' examining board.....	Collinsville.
John A. Tuttle.....	Secretary, miners' examining board.....	Harrisburg.
Joseph C. Viano.....	Member, miners' examining board.....	Coal City.
Richard Neeson.....	Mine inspector.....	Illinois Hotel, Springfield.
Walter A. Waite.....	Mine inspector, district No. 1.....	422 East Erie Street, Spring- valley.
William E. Kidd.....	Mine inspector, district No. 2.....	603 Columbia Terrace, Peoria.
Thomas P. Back.....	Mine inspector, district No. 3.....	321 West Locust Street, Canton.
Robert F. Back.....	Mine inspector, district No. 4.....	216 North English Avenue, Springfield.
Joseph Haskins.....	Mine inspector, district No. 5.....	Cattin.
John G. Millhouse.....	Mine inspector, district No. 6.....	Box 254, Litchfield.
Henry D. Thompson.....	Mine inspector, district No. 7.....	Collinsville.
Jas. R. Richards.....	Mine inspector, district No. 8.....	214 North Twelfth Street, Belleville.
Frank Rosbottom.....	Mine inspector, district No. 9.....	Duquoin.
John O'Rourke.....	Mine inspector, district No. 10.....	Mine Rescue Station, Benton.
George Bagwell.....	Mine inspector, district No. 11.....	Harrisburg.
W. L. Morgan.....	Mine inspector, district No. 12.....	Marion.
Jas. Taylor.....	Special mining investigator.....	517 Bigelow Street, Peoria.

INDIANA.

Samuel R. Artman.....	Chairman, industrial board of Indiana.....	Room 122, State Capitol, Indianapolis.
Cairy Littlejohn.....	Chief mine inspector.....	Room 102, State Capitol, Indianapolis.
Wm. Green.....	Deputy mine inspector.....	Winslow.
Albert C. Dally.....	do.....	Knightsville.
Samuel J. Wilton.....	do.....	Carbon.
John Stevely.....	do.....	Clinton.
Thos. Gillespie.....	do.....	Bicknell.

IOWA.

E. M. Gray.....	President, Iowa State mining board.....	Des Moines.
L. E. Stamm.....	Secretary, Iowa State mining board.....	Do.
W. E. Holland.....	Inspector, district No. 1.....	Albia.
R. T. Rhys.....	Inspector, district No. 2.....	Ottumwa.
Edward Sweeney.....	Inspector, district No. 3.....	Des Moines.

KANSAS.

J. H. Crawford.....	Commissioner of labor and industry.....	Topeka.
James Sherwood.....	Assistant commissioner in charge of mine inspec- tion department.	Pittsburg.
John Gore.....	Deputy mine inspector.....	Do.
Peter H. White.....	do.....	Daisy Hill.
Martin Kotzman.....	do.....	Frontenac.
Matt Dunn.....	do.....	Burlingame.
William Harvey.....	do.....	Roseland.
C. E. Perkins.....	Clerk.....	Pittsburg.
P. E. Keegan.....	Stenographer.....	Do.

KANSAS—Continued.

Name.	Designation.	Address.
<i>Mine rescue department.</i>		
James Sherwood.....	Ex-officio superintendent rescue stations.....	Pittsburg.
Geo. B. Dinneen.....	Superintendent Central mine rescue station.....	Do.
John L. Young.....	Superintendent Arma mine rescue station.....	Craveburg.
Geo. Copeland.....	Superintendent Scammon mine rescue station.....	Scammon.

KENTUCKY.

C. J. Norwood ^a	Chief inspector of mines.....	Lexington.
J. H. Salmon.....	Assistant inspector of mines, district No. 1.....	Madisonville.
C. W. Wells.....	Assistant inspector of mines, district No. 2.....	Central City.
F. C. Horton.....	Assistant inspector of mines, district No. 3.....	Lexington.
H. J. Fallon.....	Assistant inspector of mines, district No. 4.....	Middlesboro.
C. W. Arnold.....	Assistant inspector of mines, district No. 5.....	Harlan.
W. J. Noel.....	Assistant inspector of mines, district No. 6.....	Hazard.
G. C. Wells.....	Assistant inspector of mines, district No. 7.....	Paintsville.
J. F. Brown.....	Assistant inspector of mines, district No. 8.....	Ashland.

MARYLAND.

Lawrence Dunn.....	State mine inspector.....	Midland.
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MICHIGAN.

Richard H. Fletcher....	Commissioner, department of labor.....	Lansing.
Perry J. Ward.....	Deputy commissioner, department of labor.....	Do.
A. K. Smith.....	Coal-mine inspector.....	613 North Sherman Street, Bay City.
John C. Clemens.....	Mine inspector for Gogebic County.....	Bessemer.
Swan Olson.....	Deputy mine inspector for Gogebic County.....	Do.
Mat Salo.....	do.....	Ironwood.
John Brickman.....	Mine inspector for Keweenaw County.....	Ahmeek.
Gust Koikkala.....	Deputy mine inspector for Keweenaw County.....	Mohawk.
Alfred James.....	Mine inspector for Houghton County.....	Laurium.
John Allaria.....	Deputy mine inspector for Houghton County.....	Calumet.
Harry J. King.....	do.....	Laurium.
Michael Pakkala.....	do.....	Atlantic Mine.
Fred Mitchell.....	Mine inspector for Iron County.....	Iron River.
James H. Yelland.....	Mine inspector for Marquette County.....	Ishpeming.
Frank L. Larson.....	Mine inspector for Dickinson County.....	Iron Mountain.
Robt. Eva, sr.....	Mine inspector for Ontonagon County.....	Greenland.
John P. Christopher.....	Mine inspector for Barago County.....	602 Pine Street, Marquette.

MINNESOTA.

John P. Gardiner.....	Commissioner of labor and industries.....	St. Paul.
Oscar M. Sullivan.....	Chief statistician of labor and industries.....	Do.
Ed. Smith.....	Mine inspector for St. Louis County.....	Eveleth.
W. J. Trescott.....	Mine inspector for Itasca County.....	Coleraine.
August Swanson.....	Mine inspector for Crow Wing County.....	Brainerd.
F. A. Wildes.....	Chief inspector of mines, State and school lands.....	Hibbing.
A. H. Stevens.....	Deputy inspector of mines, State and school lands.....	Virginia.

MISSOURI.

George Hill.....	Chief mine inspector.....	Bevier.
Joseph Goldman.....	Secretary, State bureau of mines and mining.....	Jefferson City.
Marguerite Scherer.....	Stenographer.....	Do.
C. C. Keith.....	Inspector of lead and zinc mines.....	Joplin.
R. C. Detchmندی.....	do.....	Flat River.
C. M. Harlan.....	do.....	Cartersville.
J. A. Galbraith.....	do.....	Webb City.
Evan Jones.....	Inspector of coal mines.....	Higbee.
W. P. Craven.....	do.....	Camden.

^a Resigned, to take effect Feb. 1, 1920. Successor not named. He resumes position as head of department of mines and metallurgy, College of Engineering, University of Kentucky.

MONTANA.

Name.	Designation.	Address.
A. E. Spriggs.....	Chairman, State industrial accident board.....	Helena.
George N. Griffin.....	State coal-mine inspector.....	Do.
W. B. Orem.....	State metal-mine inspector.....	Do.

NEVADA.

George D. Smith.....	Chairman, Nevada industrial commission.....	Carson City.
A. J. Stinson.....	State mine inspector.....	Do.
Charles Huber.....	Deputy mine inspector.....	Tonopah.
Alex. Baird.....	do.....	Ely.

NEW JERSEY.

John Roach.....	Chief, bureau of mines, department of labor.....	Statehouse, Trenton.
Augustus Munson.....	State mine inspector.....	P. O. Box 311, Dover.

NEW MEXICO.

Jo E. Sheridan.....	State inspector of mines.....	Silver City.
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NEW YORK.

Edward F. Boyle.....	Chairman, State industrial commission.....	230 Fifth Avenue, New York.
L. W. Hatch.....	Chief statistician, State industrial commission..	Albany.
W. W. Jones.....	Mine inspector, State industrial commission...	Do.
Robert W. Jones.....	Inspector of mines and tunnels, State industrial commission.	230 Fifth Avenue, New York.
Gustav Werner.....	Tunnel inspector, State industrial commission..	Do.

NORTH CAROLINA.

M. L. Shipman.....	Commissioner of labor and printing.....	Raleigh.
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NORTH DAKOTA.

W. H. Robinson.....	State engineer.....	Bismarck.
J. M. Hansen.....	Assistant State engineer.....	Do.
John Hanwell.....	State mine inspector.....	209 Seventh Street, South Bismarck.

OHIO.

Thos. J. Duffy.....	Chairman, Industrial Commission of Ohio.....	Columbus.
Jerome Watson.....	Chief deputy inspector of mines, Industrial Commission of Ohio.	Do.
Miss Hazel Sims.....	Chief clerk, division of mines, Industrial Commission of Ohio.	Do.
Dan C. Jones.....	Deputy mine inspector.....	Coalton.
Jas. Dugan.....	do.....	Murray.
Andrew Ginnan.....	do.....	Jacksonville.
Elmer Sagle.....	do.....	Roseville.
E. W. Smith.....	do.....	Byesville.
Stephen Williams.....	do.....	Barnhill.
Lot Jenkins.....	do.....	Martins Ferry.
Frank P. Corey.....	do.....	Flushing.
Thomas P. Williams.....	do.....	Belmont.
Thos. G. Reese.....	do.....	Salem.
George H. Foster.....	do.....	Massillon.
Andrew Mullen.....	do.....	Amsterdam.
Percy W. Moore.....	Rescue car attendant.....	Columbus.
J. C. Wilson.....	Oil and gas well inspector.....	Do.

OKLAHOMA.

Name.	Designation.	Address.
Ed. Boyle.....	Chief mine inspector (mines, oil, and gas).....	McAlester.
Tom Scott.....	Assistant mine inspector, district No. 1.....	Coalgate.
Wm. T. Williams.....	Assistant mine inspector, district No. 2.....	Krebs.
Miller D. Hay.....	Assistant mine inspector, district No. 3.....	East Broadway Apartments, Muskogee.

OREGON.

Wm. A. Marshall.....	Chairman, State Industrial Accident Commission.....	Salem.
Henry M. Parks.....	Director, Oregon bureau of mines and geology.....	417 Oregon Building, Portland.

PENNSYLVANIA.

Seward E. Button.....	Chief, Department of Mines.....	Harrisburg.
Frank Hall.....	Deputy, Department of Mines.....	Do.
Edward C. Malick.....	Chief clerk, Department of Mines.....	Do.
<i>Anthracite inspectors.</i>		
Benjamin Maxey.....	Mine inspector, 1st district.....	Forest City.
P. J. Moore.....	Mine inspector, 2d district.....	Carbondale.
L. M. Evans.....	Mine inspector, 3d district.....	Scranton.
Jenkin T. Reese.....	Mine inspector, 4th district.....	Do.
S. J. Phillips.....	Mine inspector, 5th district.....	Do.
David T. Williams.....	Mine inspector, 6th district.....	Do.
Augustus McDade.....	Mine inspector, 7th district.....	263 North Main Street, Taylor
Robert Johnson.....	Mine inspector, 8th district.....	Pittston.
Edwin C. Curtis.....	Mine inspector, 9th district.....	West Pittston.
John B. Corgan.....	Mine inspector, 10th district.....	Kingston.
T. J. Williams.....	Mine inspector, 11th district.....	Do.
D. T. Davis.....	Mine inspector, 12th district.....	Wilkes-Barre.
Frank Kettle.....	Mine inspector, 13th district.....	Nanticoke.
Joseph J. Walsh.....	Mine inspector, 14th district.....	Do.
D. J. Roderick.....	Mine inspector, 15th district.....	Hazleton.
John J. Stickler.....	Mine inspector, 16th district.....	Do.
Isaac M. Davies.....	Mine inspector, 17th district.....	Lansford.
Evan G. Evans.....	Mine inspector, 18th district.....	Coaldale.
M. J. Brennan.....	Mine inspector, 19th district.....	Pottsville.
P. C. Fenton.....	Mine inspector, 20th district.....	Mahonoy City.
A. B. Lamb.....	Mine inspector, 21st district.....	Shenandoah.
William Reid.....	Mine inspector, 22d district.....	Centralia.
B. I. Evans.....	Mine inspector, 23d district.....	Mount Carmel.
P. J. Friel.....	Mine inspector, 24th district.....	Shamokin.
Charles J. Price.....	Mine inspector, 25th district.....	Lykens.
<i>Bituminous inspectors.</i>		
Alexander McCanch.....	Mine inspector, 1st district.....	Monongahela.
C. B. Ross.....	Mine inspector, 2d district.....	Latrobe.
Thomas K. Adams.....	Mine inspector, 3d district.....	Mercer.
J. I. Thomas.....	Mine inspector, 4th district.....	Dubois.
Richard Maize.....	Mine inspector, 5th district.....	Uniontown.
Thomas D. Williams.....	Mine inspector, 6th district.....	Johnstown.
Charles P. McGregor.....	Mine inspector, 7th district.....	Crafton.
Joseph Knapper.....	Mine inspector, 8th district.....	Philipsburg.
Silas S. Hall.....	Mine inspector, 9th district.....	Connellsville.
Joseph Williams.....	Mine inspector, 10th district.....	Altoona.
J. J. McDonald.....	Mine inspector, 11th district.....	Greensburg.
T. J. Lewis.....	Mine inspector, 12th district.....	Punxsutawney.
William Langan.....	Mine inspector, 13th district.....	Elizabeth.
David Young.....	Mine inspector, 14th district.....	Freeport.
Alexander Monteith.....	Mine inspector, 15th district.....	Patton.
W. H. Howarth.....	Mine inspector, 16th district.....	Brownsville.
John I. Pratt.....	Mine inspector, 17th district.....	5494 Hays Street, Pittsburgh.
Thomas A. Mather.....	Mine inspector, 18th district.....	Tyrone.
James J. Stoker.....	Mine inspector, 19th district.....	Irwin.
F. W. Cunningham.....	Mine inspector, 20th district.....	Somerset.
C. P. Byrne.....	Mine inspector, 21st district.....	Charleroi.
John F. Bell.....	Mine inspector, 22d district.....	Dravosburg.
Edward E. Girod.....	Mine inspector, 23d district.....	Masontown.
Nicholas Evans.....	Mine inspector, 24th district.....	Johnstown.
Thomas S. Lowther.....	Mine inspector, 25th district.....	Indiana.
P. J. Callaghan.....	Mine inspector, 26th district.....	Bridgeville.
Harry Phythyon.....	Mine inspector, 27th district.....	Belle Vernon.
Thomas H. Thompson.....	Mine inspector, 28th district.....	Punxsutawney.
Patrick S. King.....	Mine inspector, 29th district.....	612 North Canal Street, Pittsburgh, N. S.
C. H. Crocker.....	Mine inspector, 30th district.....	Johnstown.

SOUTH DAKOTA.

Name.	Designation.	Address.
Otto Ellerman.....	State mine inspector.....	Lead.

TENNESSEE.

A. W. Evans.....	Chief mine inspector.....	Nashville.
R. D. Field.....	Eastern division.....	Knoxville.
D. T. Jenkins.....	Middle division.....	Wilder.
J. P. Robinson.....	Western division.....	Cowan.

TEXAS.

B. S. Gentry.....	State mine inspector.....	Post Office Box 327, Rockdale.
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UTAH.

Preston A. Thatcher.....	Chairman, Industrial Commission of Utah.....	Salt Lake City.
John Crawford.....	State coal-mine inspector.....	State Capitol, Salt Lake City.
Carl A. Allen.....	Metal-mining engineer, Bureau of Mines.....	Salt Lake City.

VIRGINIA.

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